

# INTERFACE AGE™

MICROCOMPUTING FOR SMALL BUSINESS AND HOME

VOLUME 3, ISSUE 3

MARCH 1978

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... IN BASIC**

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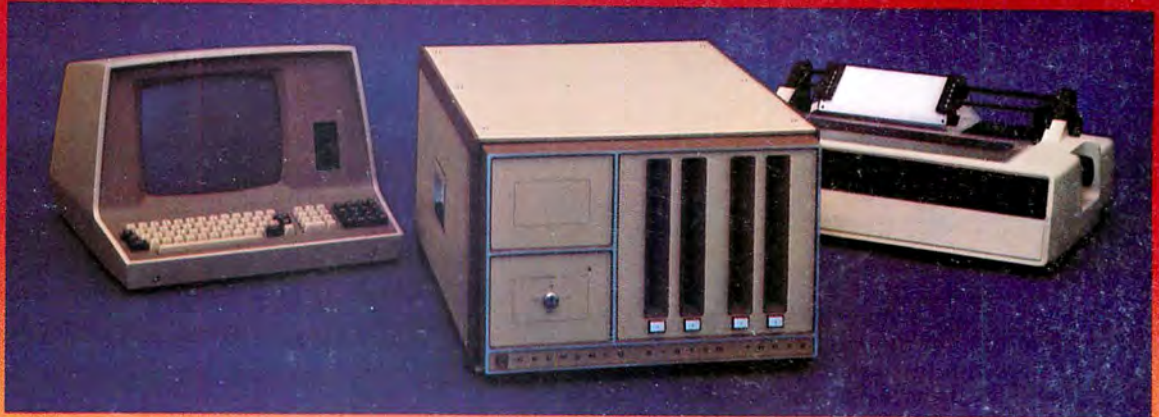


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CIRCLE INQUIRY NO. 44



# Now we can announce it— the multi-disk drive System Three Computer



**A fast Z80 microcomputer with up to 512 kilobytes of RAM, 4 disk drives and 1 megabyte of disk storage—with CRT terminal and fast printer. Even an optional PROM programmer. Strong software support, too, like FORTRAN IV, Extended BASIC, and Macro Assembler.**

## PROFESSIONAL GRADE— FOR PROFESSIONALS

Chances are you've already heard that there is a Cromemco System Three Computer. We've proudly previewed it at WESCON on the West Coast and NYPC on the East Coast.

It's a complete system—processor, CRT terminal, line printer.

First it's fast—1 microsecond nominal execution time and 250 nanosecond cycle time.

Its equally fast RAM memory is large and enormously expandable—32 kilobytes expandable to 512 kilobytes. No danger of obsolescence from inadequate RAM capacity.

## THE ONLY MICROCOMPUTER OFFERING 4 DISK DRIVES

Further, the System Three comes with two disk drives to give you 512 kilobytes of disk storage. Soft-sectored IBM format. Optionally, you can have four drives with 1 megabyte of storage.

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## 21-SLOT MOTHERBOARD

This new CS-3 is a computer that won't be outdated soon. It has a 21-

card-slot slide-out motherboard and an S-100 bus so that you can plug in all sorts of support circuitry. The heavy-duty 30-amp power supply can easily handle all this.

## BROAD S-100 SUPPORT

The S-100 is the bus that Cromemco so strongly supports with over a dozen plug-in circuits ranging from analog I/O to high-speed RAM memory with our bank-select feature.

## TRULY POWERFUL SOFTWARE

You have to have software. And Cromemco is far in front there, too. Our FORTRAN IV, for example, is equal to the FORTRAN compilers on large mainframes. Further, it (and our other software) is low-priced.

Our 16K Z80 BASIC is one of the fastest and most capable. Full 14-digit precision.

There's also our Z80 Macro Assembler and Linking Loader. Uses Z80 mnemonics. Allows referencing FORTRAN common blocks.

## SEE AT YOUR DEALER

You have to see the CS-3 to fully appreciate it and its low prices starting at \$5990 in the rack mount version. Better contact your dealer now.

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CIRCLE INQUIRY NO. 10





This month's cover is symbolic of the growth of technology through the ages. Beginning with the caveman's invention of the wheel, but looking towards the future, for even a better life.

Now as we approach the 1980s, the rapid growth of technology, particularly in the field of computer science, has further broadened man's possibilities. These advancements over the ages have made life a breeze, and opened the doors to sailing into the future.

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# INTERFACE AGE™

**MICROCOMPUTING FOR SMALL BUSINESS AND HOME**

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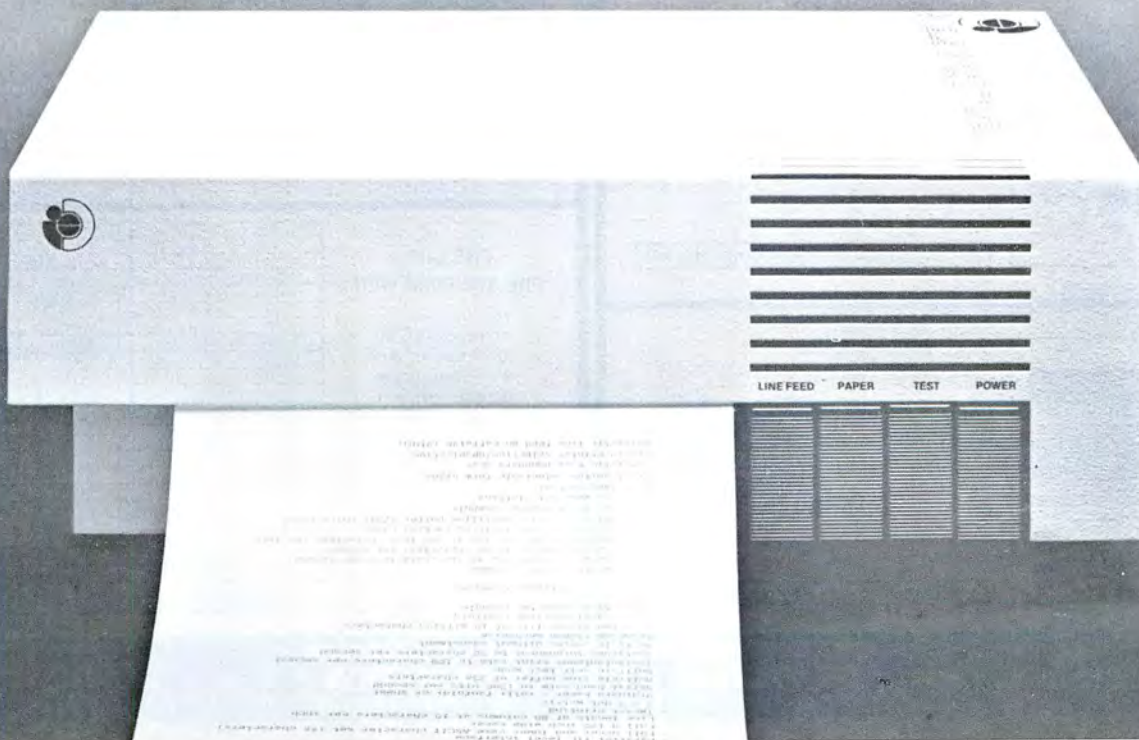
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**IP-225**

**"The Tractor Impact"**

only **\$949**

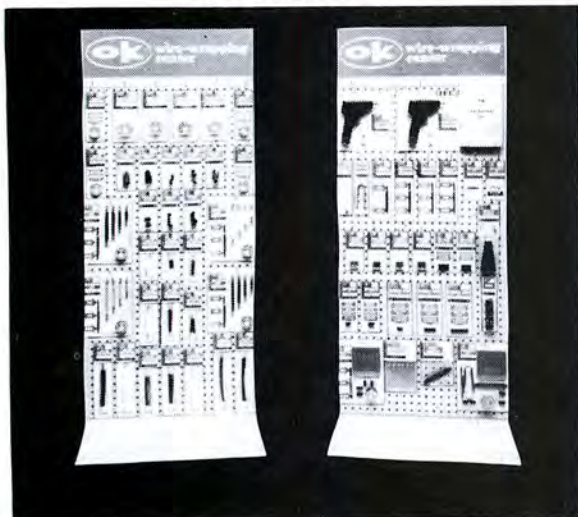
the pin feed version of the IP-125 with tractor drive forms control plus all the standard features of the IP-125.







# wire wrapping center



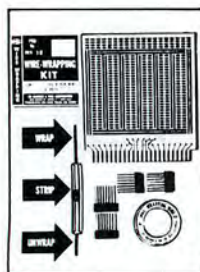
for quality electronic parts and tools.



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Contains: Hobby Wrap Tool WSU-30, (50 ft.) Roll of wire Prestripped wire 1" to 4" lengths (50 wires per package) stripped 1" both ends.

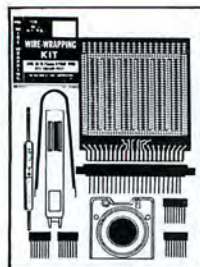
Wire Wrapping Kit. (Blue)	WK-2-B	\$12.95
Wire Wrapping Kit. (Yellow)	WK-2-Y	\$12.95
Wire Wrapping Kit. (White)	WK-2-W	\$12.95
Wire Wrapping Kit. (Red)	WK-2-R	\$12.95



## WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30, Roll of wire R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

Wire-Wrapping Kit	WK-3B (Blue)	\$16.95
-------------------	--------------	---------



## WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

Wire-Wrapping Kit	WK-4B (Blue)	\$25.99
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## HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0.63mm) Square Post.

Regular Wrap	WSU-30	\$6.95
Modified Wrap	WSU-30M	\$7.95

## NEW

HOBBY-WRAP Model BW-630

Battery wire wrapping tool COMPLETE WITH BIT AND SLEEVE



## WIRE-WRAPPING TOOL

For .025" (0.63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	\$34.95*
For AWG 26-28	BW-2628	\$39.95*

Bit for AWG 30	BT-30	\$3.95
Bit for AWG 26-28	BT-2628	\$7.95

\*USE "C" SIZE NI-CAD BATTERIES

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## ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30-AWG Blue Wire, 50ft. Roll	R-30B-0050	\$1.98
30-AWG Yellow Wire, 50ft. Roll	R-30Y-0050	\$1.98
30-AWG White Wire, 50ft. Roll	R-30W-0050	\$1.98
30-AWG Red Wire, 50ft. Roll	R-30R-0050	\$1.98



## WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B	\$3.95
Yellow Wire	WD-30-Y	\$3.95
White Wire	WD-30-W	\$3.95
Red Wire	WD-30-R	\$3.95

## PRE CUT PRE STRIPPED WIRE

Wire for wire-wrapping, AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.



30-AWG Blue Wire, 1" Long	30-B-50-010	\$ .99
30-AWG Yellow Wire, 1" Long	30-Y-50-010	\$ .99
30-AWG White Wire, 1" Long	30-W-50-010	\$ .99
30-AWG Red Wire, 1" Long	30-R-50-010	\$ .99
30-AWG Blue Wire, 2" Long	30-B-50-020	\$1.07
30-AWG Yellow Wire, 2" Long	30-Y-50-020	\$1.07
30-AWG White Wire, 2" Long	30-W-50-020	\$1.07
30-AWG Red Wire, 2" Long	30-R-50-020	\$1.07
30-AWG Blue Wire, 3" Long	30-B-50-030	\$1.16
30-AWG Yellow Wire, 3" Long	30-Y-50-030	\$1.16
30-AWG White Wire, 3" Long	30-W-50-030	\$1.16
30-AWG Red Wire, 3" Long	30-R-50-030	\$1.16
30-AWG Blue Wire, 4" Long	30-B-50-040	\$1.23
30-AWG Yellow Wire, 4" Long	30-Y-50-040	\$1.23
30-AWG White Wire, 4" Long	30-W-50-040	\$1.23
30-AWG Red Wire, 4" Long	30-R-50-040	\$1.23
30-AWG Blue Wire, 5" Long	30-B-50-050	\$1.30
30-AWG Yellow Wire, 5" Long	30-Y-50-050	\$1.30
30-AWG White Wire, 5" Long	30-W-50-050	\$1.30
30-AWG Red Wire, 5" Long	30-R-50-050	\$1.30
30-AWG Blue Wire, 6" Long	30-B-50-060	\$1.38
30-AWG Yellow Wire, 6" Long	30-Y-50-060	\$1.38
30-AWG White Wire, 6" Long	30-W-50-060	\$1.38
30-AWG Red Wire, 6" Long	30-R-50-060	\$1.38

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#### P.C. BOARD

The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector, with contacts on standard .156 spacing. Edge contacts are non-dedicated for maximum flexibility.



The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Typical density is 18 of 14-Pin or 16-Pin DIP's. Components may be soldered directly to the board or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual busses running the full length of the board for complete wiring flexibility. These busses enable access from edge contacts to distant components. These busses can also serve to augment the voltage or ground busses, and may be cut to length for particular applications.

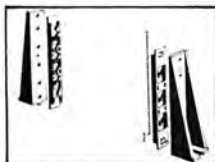
Hobby Board H-PCB-1 \$4.99



#### PC CARD GUIDES

Card Guides TR-1 \$1.89

QUANTITY — ONE PAIR (2 pcs.)



#### PC CARD GUIDES & BRACKETS

Guides & Brackets TRS-2 \$3.79

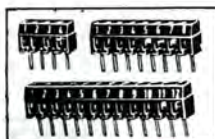
QUANTITY — ONE SET (4 pcs.)



#### PC EDGE CONNECTOR

44 Pin, dual read out, .156" (3.96 mm) Contact Spacing, .025" (0.63 mm) square wire-wrapping pins.

P.C. Edge Connector CON-1 \$3.49



#### P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1.8-0.25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

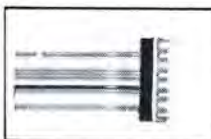
4-Pole	TS- 4	\$1.39
8-Pole	TS- 8	\$1.89
12-Pole	TS-12	\$2.59



#### DIP SOCKET

Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins .025 (0.63mm) sq., .100 (2.54mm) center spacing.

14 Pin Dip Socket	14 Dip	\$0.79
16 Pin Dip Socket	16 Dip	\$0.89



#### RIBBON CABLE ASSEMBLY SINGLE ENDED

With 14 Pin Dip Plug 24" Long (609mm)	SE14-24	\$3.55
With 16 Pin Dip Plug 24" Long (609mm)	SE16-24	\$3.75



#### DIP PLUG WITH COVER FOR USE WITH RIBBON CABLE

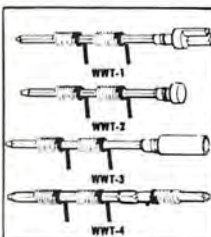
14 Pin Plug & Cover	14-PLG	\$1.45
16 Pin Plug & Cover	16-PLG	\$1.59

QUANTITY: 2 PLUGS, 2 COVERS



#### RIBBON CABLE ASSEMBLY DOUBLE ENDED

With 14 Pin Dip Plug -2" Long	DE 14-2	\$3.75
With 14 Pin Dip Plug -4" Long	DE 14-4	\$3.85
With 14 Pin Dip Plug -8" Long	DE 14-8	\$3.95
With 16 Pin Dip Plug -2" Long	DE 16-2	\$4.15
With 16 Pin Dip Plug -4" Long	DE 16-4	\$4.25
With 16 Pin Dip Plug -8" Long	DE 16-8	\$4.35

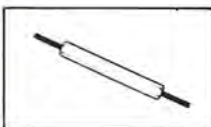


#### TERMINALS

- .025 (0.63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

Slotted Terminal	WWT-1	\$2.98
Single Sided Terminal	WWT-2	\$2.98
IC Socket Terminal	WWT-3	\$3.98
Double Sided Terminal	WWT-4	\$1.98

25 PER PACKAGE



#### TERMINAL INSERTING TOOL

For inserting WWT-1, WWT-2, WWT-3, and WWT-4 Terminals into .040 (1.01mm) Dia. Holes.

INS-1 \$2.49



#### WIRE CUT AND STRIP TOOL

Easy to operate... place wires (up to 4) in stripping slot with ends extending beyond cutter blades... press tool and pull... wire is cut and stripped to proper "wire-wrapping" length. The hardened steel cutting blades and sturdy construction of the tool insure long life.

Strip length easily adjustable for your applications.

DESCRIPTION	MODEL NUMBER	ADJUSTABLE "SHINER" LENGTH OF STRIPPED WIRE		Price
		INCHES TO	INCHES	
24 ga. Wire Cut and Strip Tool	ST-100-24	1 1/4"	1 1/4"	\$ 8.75
26 ga. Wire Cut and Strip Tool	ST-100-26	1 1/4"	1 1/4"	\$ 8.75
26 ga. Wire Cut and Strip Tool	ST-100-26-875	7/8"	1 1/4"	\$ 8.75
28 ga. Wire Cut and Strip Tool	ST-100-28	7/8"	1 1/4"	\$11.50
30 ga. Wire Cut and Strip Tool	ST-100-30	7/8"	1 1/4"	\$11.50

THE ABOVE LIST OF CUT AND STRIP TOOLS ARE NOT APPLICABLE FOR NYLON OR TEFLON INSULATION

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# EDITOR'S NOTEBOOK

Several items to talk about this month: The first is related to the responses we have had on the 'QWERTY Is Obsolete' article. Many readers have had difficulty in contacting the Newo Company, and consequently are calling us instead. The Newo Company can be contacted by writing to them at 246 Walter Hays Drive, Palo Alto, CA 94303, or calling (415) 321-7979.

There seems to be a misunderstanding regarding payment policy for cartoons. Unfortunately, it was more than likely caused by us. Therefore, to clear it up, I would like to clarify our cartoon policy. Cartoons, although solicited, are by no means the prime feature within the magazine. Like articles, cartoons are evaluated as to applicability to the general editorial plan of the magazine. Which simply means that we can't and don't accept all the art work sent to us.

INTERFACE AGE Magazine offers between \$10 and \$15 per published cartoon. Cartoons are scheduled according to their general appeal and relation to editorial copy.

Cartoons serve a couple of purposes. We use them to provide a look at the lighter side of computing. Also they are used to fill the odd-sized holes that sometimes occur on magazine pages. Cartoons are wanted and needed, and hopefully this has cleared up any previous misunderstanding.

With that behind us, I would like to look at the importance of this particular issue and the industry in general.

March 1978, has every possibility of being noted as the start of a new era in the microcomputer field. The reasoning behind this is that the industry is gearing itself to the total consumer computer. Computer exhibitions are planning to demonstrate the power of the small computer as a viable tool to be used in the home and small businesses.

The Micro-Business '78 exposition, March 17-19 at the Pasadena Conference Center, is the first show to be dedicated toward small business users. Over 30 seminars are planned covering every aspect of small business computing. Within this issue, we have provided a complete guide to the show, along with

summaries of each of the seminars to be presented. The show itself promises to be interesting and will answer questions that up until now have gone unanswered.

In line with the show, and the growth of the industry, we are also providing a definitive directory of new products. Hopefully the small businessman will be able to attend the show, then use the directory to choose the equipment needed.

Although the small business community offers the greatest growth potential for the industry, the area of consumer computers is also important, and is being addressed by manufacturers. Last month Mike Peak introduced the VideoBrain, which is one of the first entrants into this new field of consumer computer electronics. However, other companies are realizing the importance of supplying computer-controlled devices to the general public.

Car manufacturers are announcing computer monitoring of vital electrical and mechanical systems. Amana is providing micro-processor control of their new radar ranges. For the most part the use of the micro is transparent to the end user, but it is finding its way into everyday life.

Twenty-three years ago, October 9, 1955, NBC Television aired a special featuring Dave Garroway. This show, called 'American Petroleum Institute 1976', was a prophecy of things to come. Mr. Garroway, in his in-depth review, presented the possibilities of personal communications. We now have citizens band radio. He also introduced the concept of the microcomputer, and hinted at computer assisted instruction in the home. Control of the home environment, automated bill paying and grocery shopping were shown as future wonders. Many of the prophecies have come to pass, with many more on the way.

Education in the home is not far in the future. With the advent of the consumer computer and software packages geared to education, it is on the brink of being a realistic consumer commodity.

The future advancements, shown in 1955, were only partially pipe dreams. With the race for space just beginning it was only a matter of

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time before industry had achieved the expertise that was required to make it happen. Literally overnight advancements in semi-conductor technology took place. A completely new technology was on the drawing boards, that of large scale integration. Now twenty-three years later we are able to take full advantage of the dreams of a few pioneers and create our own future prophesies.

What will these next 23 years bring? With the rapid growth of technology, we will hope to see completely automated houses. Everything from answering the phone to taking out the trash will be under some form of computer control. Robots will become a commonplace fixture in industry, within the next five years, and within fifteen years automated

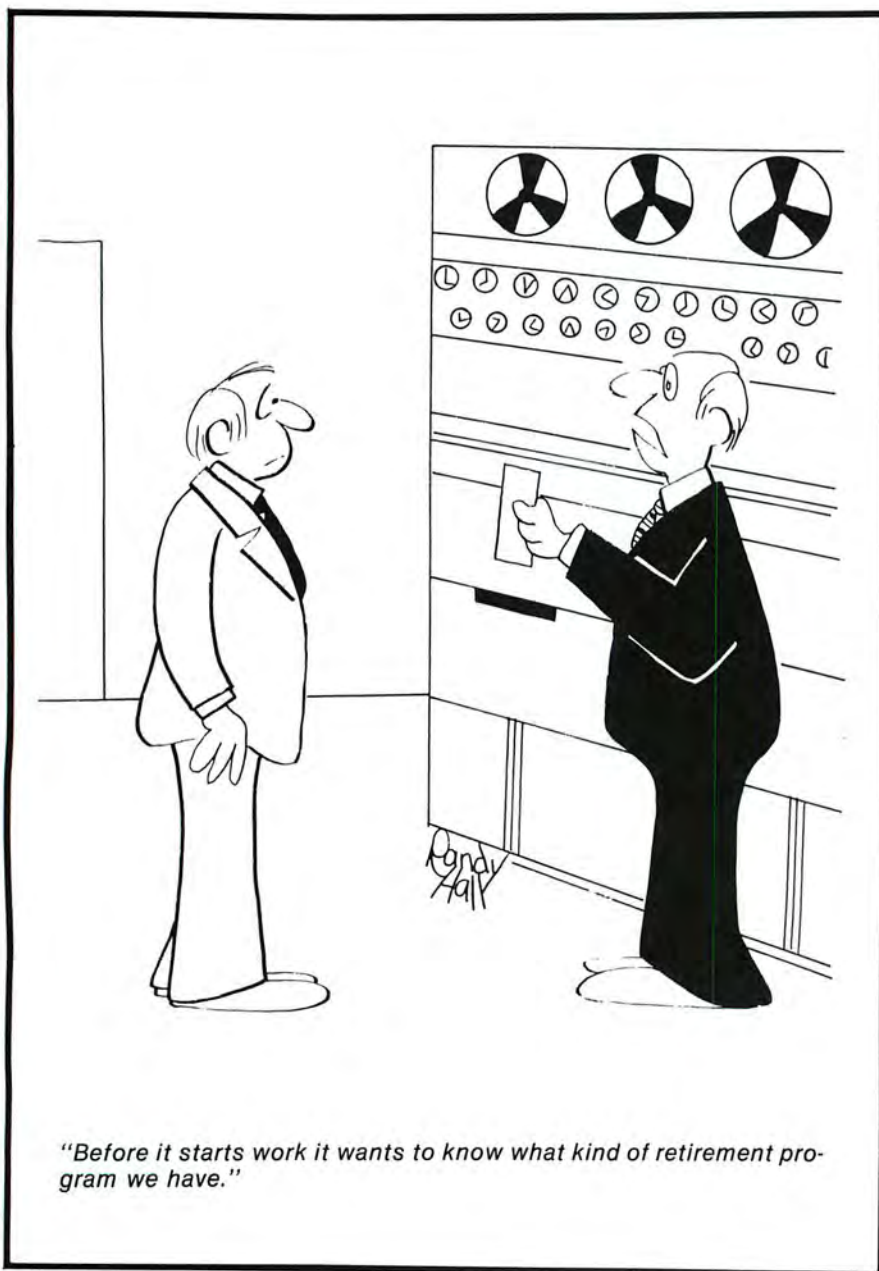
household servants will be available to the general public.

LSI Technology is and will provide us with the method and tool to make important advancements in medicine, education, science, and of course help in freeing the masses from the drudgery of work.

The computer, the wonderful machine, will be a tool to be used by humans. With all the advancements that have been made and all the exciting things to come, the man/machine interface becomes even more important.

Therefore, let March 1978 mark the epoch of a new era in consumer computing. An era dedicated to assiting mankind reach his greatest potential. □

Carl



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CIRCLE INQUIRY NO. 1





# LETTERS TO THE EDITOR

Dear Editor:

I like your magazine a lot. At the moment I subscribe to 'all' of them — yours I plan to renew.

There is a problem, however: often I am unable to use the BASIC programs that various authors have supplied to you. The reason, of course, is that BASIC has been elaborated upon by the various companies which sell interpreters. The result is that we don't usually have the original Dartmouth instruction set, but only part of it — the rest is characteristic of the vendor.

Some systems are better than others, but the individual who attempts to use your published programs is 'stuck' with whatever he has. As a case in point, consider the excellent and timely articles by James J. Brennan, which appeared in your August 1977 issue: Nowhere is it indicated what equipment he has run his programs upon. Nowhere is it indicated whose BASIC he has used. What is a reader to do with (page 33) line 1001 and 1002 — is that a User Defined Function? If so, at what line does he leave the function? If it is some sort of double precision arithmetic — what do you do if you don't have it?

I feel that the problem could be solved if you would require your authors to identify 'non-standard' symbols and make it clear what they do in the author's program. Another thing that would help a lot would be for you to print the instruction of every kind of BASIC being marketed — if you did, that issue would be a collector's item for years.

Felix Montro  
San Antonio, TX

*Point well taken. BASIC may be the universal language, but only if you know the dialect.* Carl

Dear Editor:

I was wondering if you have any calculator game programs for a Texas Instruments calculator. If you sell them could you please send me a price list.

Wayne Repchuk  
Edmonton, Alberta, Canada

*Wayne, you might check dilithium Press. See their ad in this issue. They offer a calculator book.* Carl

Dear Editor:

Having just acquired a Diablo series 1345 HyType Printer, I am in the process of interfacing it to a Processor Technology SOL 20 with 32K of memory.

In order to get operating quickly it is being initially interfaced as described for the "Qume" by Jeff Ras-kin, using a software driver. The driver will initially be homebrew. Hopefully, I can later get a copy of the software driver said to be available through the Intel 8080 Users Group.

This kind of interface will not fully utilize the potential of this type of printer, especially in graphics, and will also occupy a considerable chunk of memory. In order to more fully utilize the printer's potential and to minimize the I/O pin assignments to the PTC 3P+S module, I would like to purchase, construct or otherwise acquire a set of PC boards for an 8080 Terminal Micro-processor and interface which will plug into the two spare 56 contact sockets in the printer motherboard. This would in effect convert the printer into a complete terminal with pretty extensive capabilities. The very expensive set of boards available through Diablo also converts the extensive parallel interface to a five wire RS-232 interface.

This type of printer has recently become widely available in volume on the surplus market. It would seem to me that it may well be the wave of the future for the serious hobbyist. Such a PC board set might make a good series of articles for INTERFACE AGE, especially if accompanied by a solder-tail PC board kit. There isn't room for wire wrap.

It is possible that someone has already done this. If so, I would like to get into contact with him. Failing that, with someone who is interested in developing such a board. Any advice that you can give or help that you may care to offer will be gratefully appreciated.

Peter Nevius  
2419 Brookshire Dr.  
Schenectady, NY 12309

*Readers, can you help Peter out?* Carl

Dear Editor:

I own a model MT200 Remington Word Processing System (dual cassettes) and am interested in interfacing with a microprocessor, preferably one with an S100 bus or SWTPCs SS-50 bus.

I prefer not to lose any of the functions of the present system so I would be satisfied using the Model 745 IBM Selectric in the Remington system for hard copy printout only, if the system remained intact so that it would simultaneously be recording on its own cassettes. However, I feel that I should be able to interface one of the cassette transports in the Remington system (made by Redac-tron) to a computer and be able to record from the computer on the cassette and play back through the Remington system if I had the proper interface and the correct operating system, code, software, etc. to make compatible recordings.

My ultimate goal is to be able to handle much of the word processing and editing on a video screen before printing out on hard copy, and then later adding floppy disks and setting up the bookkeeping system for my small business on the computer.

Any help that you could give me would be greatly appreciated. I have full documentation on the system and am fairly experienced in reading schematics and kit building.

Glenn Harrison  
5335 Lee Highway  
Arlington, VA 22207

*Glenn, you have some excellent projects planned and to help you along we are publishing your address. Hopefully several readers can give you what you need.* Carl

Dear Editor:

I am getting awful tired reading about what has to be done to get an operational Tarbell cassette interface board, reference your December 1977, J.R. Schmidt article. All the circuit mods that he, and others, recommend can be avoided if the Tarbell-recommended low cost J.C. Penney Model 6536 recorder is used. It has an auxiliary input with separate volume control, getting around the recording level problem No. 1. The tone control is common with the condenser mike on-off switch, how-



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Now INFO 2000 offers its high-performance Disk System for your Heathkit H8 Computer, and upgrades your system to a Z80 in the process! Simply unplug your Heathkit 8080 CPU board, and replace it with the **INFO 2000 Z80/Disk Adapter Board** instead. This remarkable board combines a Z80 microprocessor and all support chips, 7K of EPROM and 1K of scratchpad RAM for the **INFO 2000 Disk Monitor**, and all logic necessary to interface the **INFO 2000 Disk System** to the Heathkit H8.

With the **INFO 2000 Z80/Disk Adapter** board installed, your H8 Computer can operate in either of two switch-selectable

## YOUR QUESTIONS ANSWERED.....

### WHAT ARE THE TECHNICAL DIFFERENCES BETWEEN THE INFO 2000 DISK SYSTEM AND OTHERS?

The **INFO 2000 Disk System** is the only one which has an intelligent controller with its own on-board microprocessor and file management firmware. It is the only one which provides all of the EPROM and RAM needed for its disk Monitor software, and therefore does not use up a single byte of your system RAM. It uses the industry-standard single-density FM recording technique and soft-sectored diskettes to provide nearly complete immunity to read/write errors. (Double-density recording is extremely intolerant to speed variations, dirty heads, flawed media, etc., and so is an order of magnitude less reliable.) It offers the most complete software support of any disk system. It is available for all S-100, Heathkit H8 and Digital Group systems with total file and program interchangeability. And it is priced lower than competitive disk systems.

### WHAT MAKES YOU SAY THAT YOUR PRICES ARE LOWER THAN OTHERS?

Let's look at the cost of the **INFO 2000 Disk System** in comparison to the most comparable disk systems from Cromemco and Processor Technology. The following prices are for an 8-inch dual diskette drive, plus an S-100 diskette controller, both assembled and tested:

CROMEMCO	\$3,090
PROC. TECH.	\$2,895
INFO 2000	\$2,850

If the cost of software is included in the comparison, the **INFO 2000** cost picture looks even more favorable. (For example, our disk monitor on EPROM is included in the \$2,850 price, while their disk-resident monitors cost \$75 to \$100 extra.) Similar "apples-with-apples" price comparisons between the **INFO 2000 Disk System** and the Processor Technology Helios, the iCOM dual 8" system, and other competitive systems yield similar results. However, we think you should buy the **INFO 2000**

modes. One mode permits the use of the Heath H8 EPROM monitor and all existing Benton Harbor software without modification (but provides the speed advantages and extended instruction set of the Z80). The other mode supports the **INFO 2000 Disk Monitor** and all **INFO 2000** software including the TDL software library and CP/M.

The complete **INFO 2000 Disk System** for the Heathkit H8 costs \$2,950 — this is \$100 more than our S-100 and Digital Group systems, but includes the upgrade to a Z80 processor as part of the deal. Contact **INFO 2000** for further details of this exciting new product.

**Disk System** because it is the best on the market, not because it is the cheapest.

### HOW ABOUT THE TWO-DRIVE MINIFLOPPY SYSTEMS THAT ARE UNDER \$1,500?

Minifloppies seem like quite a bargain, until you realize that they are about half the cost of the full-size 8" diskette systems but offer only one-third of the capacity and one-sixth of the speed. Our experience indicates that minifloppies are an attractive alternative to cassettes for loading programs, but are simply not viable for serious data management work such as business applications.

### WHAT ELSE DOES INFO 2000 SELL?

An increasingly important part of our business is helping customers to configure and acquire complete disk-based microcomputer systems optimized for their specific requirements. You may be interested in discussing the advantages of purchasing a total computer system from **INFO 2000**, and having us assemble and test the entire configuration together before it is delivered to you. We also offer the **INFO 2000 Business System**, complete with outstanding accounting and word processing software, for less than \$10,000. Send for our business system brochure.

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Please feel free to write **INFO 2000** with any questions you may have regarding our products. All letters will be answered promptly with a detailed reply and with technical and pricing information. At **INFO 2000** we take pride in providing personal consultation and support to our customers. We look forward to hearing from you.

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ever if the mike is switched off (or hardwired off — a simple mod) when recording, the ambient noise problem No. 2 is avoided, with no effect on the tone of the recording, as the tone control only works during playback and is bypassed in the recording mode.

In over a year's use of this cost ef-

fective recorder, without any Tarbell interface board mods, I and many other users of the board have obtained a very high degree of reliability. Use of low noise/high frequency response tape also helps. Our experience with some of the more expensive higher fidelity cassette recorders, as recommended, has shown that

they don't work in this application.

Sy Lieberman  
Sherman Oaks, CA

*Your points are well taken and we do appreciate them. However, the main point is, this is a hobby and if someone has an idea they deserve the right to share it.*

Carl

Dear Editor:

Concerning Goble's article on the S-100 bus structure in the June 1977 issue, he has the data bit 2 and data bit 1 pins reversed on page 67 and 68. It should be: DO2 Pin 35 not 88; DI2 Pin 94 not 41, DO1 Pin 88 not 35, and DI1 Pin 41, not 94.

This can be checked in the MITS schematics, or any of the aftermarket S-100 memory or accessory boards.

It is most unfortunate that an error like this has to occur, as not everyone will see the correction. A good magazine, all in all.

Pat Staken  
Greenbelt, MD

*Pat, errors do sometimes occur, but it's readers like yourself that keep us on our toes.*

Carl

Dear Editor:

I sent you a check as subscription charge for 1978 of the INTERFACE AGE Magazine. I gave it as a Christmas present to my boy of 15, who is very interested in microcomputers and just started building a 6800 system.

His name is Bengt Gustafsson. The address is Hagsattersvagen 1, S-597 00 Atvidaberg, Sweden. I think he also should be glad if you know any boy at the same age and with the same interests to correspond with. Spell a with ae and A with AA if you haven't the right letter.

Lars Gustafsson  
Sweden

*Here is a chance for our younger readers, and even the older ones, to have a pen pal.*

Carl

Dear Editor:

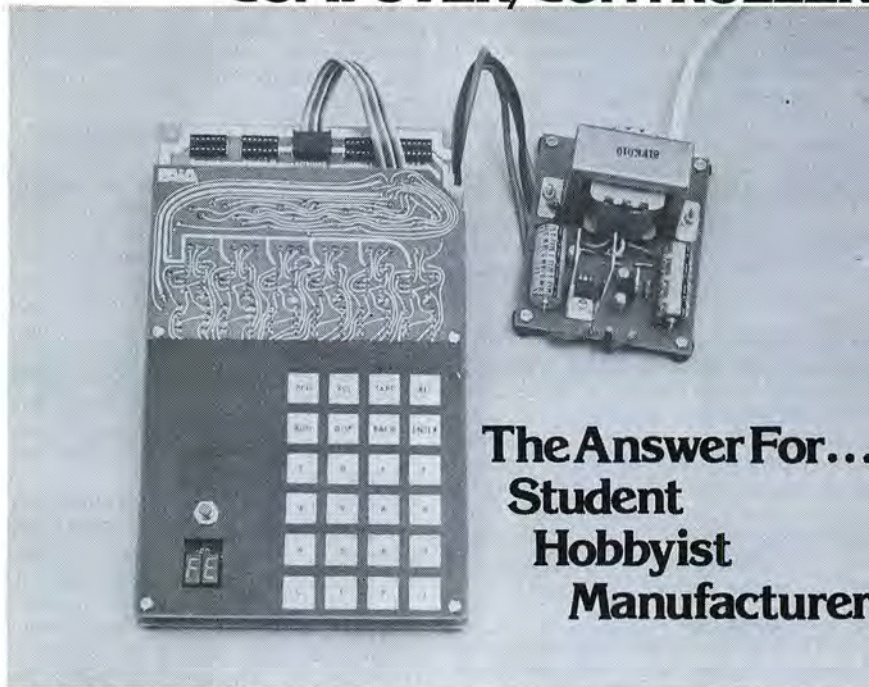
Do you have an annual index to your magazine's articles?

Richard Styrzcula  
Orland Park, IL

*Not yet, but plan on one in our May issue.*

Carl

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**BECAUSE . . .** After extensive engineering design and testing by Micro Computer Devices, IBM Corporation has approved the SELECTERM for use with your microcomputer, and provides you with their factory warranty and yearly service agreement for the typewriter. In addition, the electronics conversion portion is fully warranted by Micro Computer Devices.

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**IT'S THAT EASY!**

**AND THAT RELIABLE!**

#### FEATURES

- Complete ASCII character set in supplied element.
- Full upper, lower case alphanumeric characters.
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- Parallel Interface, standard.

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- Power supply, electronics and cable sets included to permit immediate connection to the parallel port of any computer, at standard TTL level.

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- All necessary conversion software in PROM to handle ASCII input, directly.

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#### PRINTER or TYPEWRITER

- May be used as a standard typewriter when not in use with your computer.

#### OPTIONS

- Dual Pitch, \$125
- Correction Feature, \$125
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#### AVAILABLE SOON

- RS-232 Interface

#### PRICE and DELIVERY

- Assembled and tested, \$1750
- Available ONLY from authorized dealers.
- Delivery 1 to 2 weeks from receipt of order.
- OEM delivery in quantity within 30 days.

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*"Innovators to the Microcomputer Industry"*



## UPCOMING COMPUTER SHOWS

May 13: Birmingham Amateur Radio Club, Inc. announces the Birminghamfest '78. This computer show, held at the Jefferson Civic Center in Birmingham, Alabama, will be very interesting. There will be many different exhibits with plenty of display area. For more details write Chet Lambert, Exhibition Chairman, 1704 Sam Drive, Birmingham, Alabama 35235.

May 23-25: The Sheraton Boston Hotel will be hosting Electro '78. At this Electronic Show and Convention there will be many displays of high technology electronics. The exhibits will be shown at Hynes Veterans Auditorium in Boston. The program will be held at the Sheraton Boston Hotel. For further information call (213) 772-2965, or write Western Electronic Show & Convention, 999 N. Sepulveda Blvd., El Segundo, CA 90245.

November 16 & 17: The California Educational Data Processing Association (CEDPA) will be sponsoring a convention and trade show. It will be held at the Registry Hotel, 18800 MacArthur Blvd. (at the Orange County Airport), Irvine, CA. For convention information, contact Sam Price, DPM, U.C. Davis School of Medicine, Davis, CA 95616, (916) 752-3234. For exhibition information contact Ellen Landers, Show Manager, 17039 Tulsa Street, Granada Hills, CA 91344, (213) 360-2786.

## MICROCOMPUTER CHESS TOURNAMENT

The 2nd Annual West Coast Computer Faire will be the host of the microcomputer chess tournament held March 3, 4, and 5 at the San Jose Convention Center. This tournament will have microcomputers playing against each other. If you would like to enter your computer and program please contact the tournament director Larry Wagner, or the tournament coordinator Roy Elder at (408) 745-2810.

## PERCOMP '78

Eight free seminars and demonstrations are scheduled for PERCOMP '78, April 28-30 at the Long Beach Convention Center, Long Beach, California. Included are the following presentations: "Marketing for the New Manufacturer," David Ahl, Creative Computing; "Three Dimensional Microcomputer Graph-

ics," Bruce Artwick, Sublogic; "6530 Timer Programming," Arthur Stoll, Rockwell International; "Human Factors in Software Design," Jack Emerichs, A.O. Smith; "Computer Games," James Butterfield, author of The First Book of KIM; "Getting Started in Microcomputers," Louis Fields, president, International Computer Society/SCCS; "The 'Jogger' Microprocessor Communication Bus," Dr. Keith L. Doty, University of Florida. For more information,

write PERCOMP '78, 1833 E. 17th St., Santa Ana, CA 92701.

## COMMUNITY COLLEGE COMPUTING CONFERENCE

May 5 and 6 will be the dates for the Northern California Community College Computing Consortium Spring Conference. The conference will be held at Sierra College, 5000 Rocklin Rd., Rocklin, CA 75677. For further information contact Perry Edwards at (916) 624-3333.

## SUPPORT YOUR LOCAL COMPUTER STORE

We could have run an ad that said "buy your books directly from us" but that's not to your advantage. If you look at our books at a computer store you can decide which ones meet your needs. We know that you will decide on two or three and actually *use* them. That's our goal, use! The more you know about microcomputers the more you'll want to know and that is good for you, for your local computer store and for us. If you don't know the name of your local computer store, send us your name and address. We'll tell them your name and we'll tell you their name. Once you two get together, be sure to look at some of the books on the next page.



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## SMALL BUSINESS COMPUTER EXPO

A Personal and Small Business Computer Expo is being held May 19-21 at the Exposition Hall, Orlando, Florida. Featured will be information on the following; hardware and software development, micro-computers, kit construction, computer games, disk memories, business application to computers, computerized music, digital tapes, program implementation, printers, etc. For additional information,

write Felsburg Associated, Inc., P.O. Box 735, Bowie, MD 20715 or call (301) 262-0305.

## NCC PERSONAL COMPUTING FESTIVAL

A Personal Computing Contest will add excitement and challenge to the 1978 NCC Personal Computing Festival to be held June 6-8 at the Disneyland Hotel, Anaheim, California. The Festival will be held in conjunction with the 1978 National

Computer Conference June 5-8 at the Anaheim Convention Center. For further information contact AFIPS, 210 Summit Avenue, Montvale, NJ 07645, (201) 391-9810.

## INTERFACE '78

March 6-9 will be the time of the Interface '78 conference. This conference will be one of the largest data communications conference and expositions. It will be held at the Las Vegas Convention Center. Booth space is still available. For reservations or additional information, write to Data Communications Interface '78, 160 Speen St., Framingham, MA 01701, or call toll-free (800) 225-4620.

## SOCIETY OF UNIVERSITY COMPOSERS

The American Society of University Composers will sponsor a series of discussions concerning the formation of a consortium of electronic music studios during the 1978 convention, March 22-25, at the University of Miami, Coral Gables, Florida. For more information contact Cleve L. Scott, Region V, ASUC, (317) 285-7072.

## CANA DATA 78

Can Data 78 is going to be held at the Sheraton Centre, Toronto, April 4, 5, and 6. This data communications conference and exhibition is sponsored by Computer Data Magazine and will show a wide range of products and services covering the varied aspects of the industry. For further information write Can Data 78, Suite 2504, 2 Bloor Street West, Toronto, Ontario, M4W 3G1

## TRENTON COMPUTER FESTIVAL

The third annual T.C.F. will be happening again on April 22-23. There will be many conferences featuring: Microcomputers in the home, amateur radio, education and medicine; consumer applications of micros; computer music, etc. For additional information call (609) 771-2487 or (201) 277-2063.

## ACM 1978 ANNUAL CONFERENCE ISSUES CALL FOR PAPERS

The 1978 Annual Conference of the Association for Computing Machinery, which will be held December 4-6, at the Sheraton Park Hotel in Washington, D.C. has issued a Call for Papers. The program will cover all aspects of computer science and applications. There will also be a program stressing current applica-

## THE ANSWER BOOKS FOR HOME COMPUTER HOBBYISTS—

### HOME COMPUTERS: 2<sup>10</sup> QUESTIONS AND ANSWERS

by Rich Didday

Volume 1: Hardware  
This book is for the person with a micro-computer who wants to get an idea of what it can be like to use it to the fullest. \$7.95 '77

Volume 2: Software  
A companion volume to the above book, this guide leads the new micro owner through the thorny problems surrounding the selection and use of software. \$6.95 '77

### STEP BY STEP INTRODUCTION TO 8080 MICROPROCESSOR SYSTEMS

by David Cohn and James Melsa  
This is a more advanced book which will show you how to put together what you've learned to build systems and applications that really exploit the capabilities of your micro. \$7.95 '77

### HOME COMPUTERS: A BEGINNER'S GLOSSARY AND GUIDE

by Merl Miller and Charles Sippl  
This book provides the fundamental knowledge and skills for the new micro owner. Written in a lively and straightforward style, it takes the mystery out of the basic mathematical and logical principles involved in working with computers. \$6.95 '77

### TAKE A CHANCE WITH YOUR CALCULATOR

by Lennart Rade  
This book was written to help you discover the word of probability with your programmable calculator. You will need no previous experience either in probability theory or in programming to learn both from this book. It is self-paced so that you can teach yourself the variety of games and applications it includes. \$6.95 '77

### INTRODUCTION TO BASIC

by Jeffery B. Morton  
An introductory BASIC that covers all the topics in simple, easy-to-understand language. Nothing is left out, everything is presented in clear, step-by-step fashion. This book will make a good BASIC programmer of any reader. \$8.95

### BEGINNING BASIC

by Paul Chirlian  
Designed for the person who has essentially no experience with computers or computer programming, this book is both elementary—so that you can follow it easily, and complete—so that you will become familiar with all aspects of BASIC. \$9.95

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tions and policy matters related to computers in the Federal Government.

Submitted papers will be reviewed for selection by experts in the computer disciplines. Proposals are also invited for special sessions and panels. Five copies of all papers and/or proposals should be mailed by July 1, 1978 to: Gerald L. Engel, Dept. of Math & Computing Sciences, Old Dominion University, Norfolk, VA 23508. Or call (804) 489-6524.

#### MICROCOMPUTER INVESTORS ASSOCIATION

An association has been formed for the purpose of facilitating the exchange of data and information relating to investments and microcomputers with the express interest of such interchange being directed toward maximizing profits in stocks, bonds, warrants, stock options, and commodities — including commodity options and futures straddles. The Association is professional and non-profit in nature. Persons desiring to join the Association should send a self-addressed, stamped envelope to: Jack Williams, The Microcomputer Investors Association, 2415 Ansdell Court, Reston, VA 22091.

#### WESTERN ELECTRONIC SHOW AND CONVENTION

"Tomorrow's Lifestyle Through Electronics at WESCON/78" is the theme for this convention/show. The 1978 Western Electronic Show and Convention (WESCON) will showcase this new and exciting lifestyle of the future, as a central theme of the exhibition. This show will be sponsored by the Los Angeles and San Francisco Bay Area Councils of IEEE, and by the Northern and Southern California Chapters of the ERA. For additional information write Don Larson, 2182 Dupont Dr., Suite 203, Irvine, CA 92715, (714) 752-2671.

#### SERIES OF EXPOSITIONS SPONSORED BY ATEA

The first conference and trade exhibit dedicated to "create better communications between manufacturers and users of automatic test and measurement equipment" will be held September 26, 27, and 28. ATEA (Automatic Test Equipment Association) will be sponsoring this conference at the Boston Hynes Auditorium. Exhibit, program and additional information may be obtained by writing to William R. Hickey, President, Golden Gate Enterprises, Inc., 1307 S. Mary Ave., Suite 210, Sunnyvale, CA 94086, (408) 737-1100.

#### CALL FOR PAPERS FOR CONVENTION INFORMATIQUE

Convention Informatique is the International Congress in Software

and a meeting point for Data Processing professionals. In 1978 the Convention Informatique will be held in Paris at the Paris Convention Center (Palais des Congres) from September 18th to 22nd. Papers are particularly sought dealing with historical aspects and future prospects of the two program themes respectively, and the following areas: New Technologies, Fields of Economic Activity, and User Groups. For more information contact: International Trade Shows in France, 1350 Avenue of the Americas, NYC 10019, (212) 582-4970.

#### CALL FOR PAPERS FOR AMATEUR COMPUTING '78

The Amateur Computing '78 microcomputer festival will be held July 22-23 at the Sheraton National Motor Hotel, Arlington, Virginia. Those interested in presenting a paper, participating in a panel discussion, displaying an amateur computer system or sponsoring a tutorial, should submit a letter of intent along with a one-page abstract or outline by April 15 to John W. Miller, Program Chairman, 6921 Pacific Lane, Annandale, VA 22003. Or call (703) 256-5702. Areas of interest are: personal computing; amateur radio and microcomputers; home educational uses of computers; speech, music and graphics; standards for hardware, software and interfacing to the real world. Information on Amateur Computing '78 may be obtained by writing AMRAD, P.O. Box 682, McLean, VA 22101.

#### COMPUTER MAPPING SOFTWARE AND DATA BASES CONFERENCE

Harvard University's Laboratory for Computer Graphics and Spatial Analysis has announced a five-day International User's Conference on *Computer Mapping Software and Data Bases: Application and Dissemination*, from July 23 through July 28, 1978.

The conference will review the work of Harvard, other organizations, and federal, state and local governmental agencies using computer mapping programs. Particular emphasis will be placed on user application, software and data base availability, research results on the principles of thematic map design and more effective procedures for computer software and data base distribution, as well as case studies of use applications and user costs. Participants may attend the complete five-day program or selected workshops. For further information contact Peggy Kilburn, Center for Management Research (conference coordinators), 850 Boylston Street, Chestnut Hill, MA 02167, (617) 738-5021.

# Your Sol dealer has it.

AZ: Tempe: Byte Shop, 813 N. Scottsdale, (602)894-1129; Phoenix: Byte Shop, 12654 N. 28th, (602)942-7300; Tucson: Byte Shop, 2612 E. Broadway, (602)327-4579. CA: Berkeley: Byte Shop, 1514 University, (415)845-6366; Citrus Heights: Byte Shop, 6041 Greenback, (916) 961-2983; Costa Mesa: Computer Center, 1913 Harbor, (714)646-0221; Hayward: Byte Shop, 1122 "B" St., (415)537-2983; Lawndale: Byte Shop, 16508 Hawthorne, (213)371-2421; Orange: Computer Mart, 633-B W. Katella, (714) 633-1222; Pasadena: Byte Shop, 496 S. Lake, (213)684-3311; Sacramento: Micro-Computer Application Systems, 2322 Capitol, (916) 443-4944; San Francisco: Byte Shop, 321 Pacific, (415)421-8686; San Jose: Byte Shop, 2626 Union, (408)377-4685; San Rafael: Byte Shop, 509 Francisco, (415)457-9311; Tarzana: Byte Shop, 18423 Ventura, (213)343-3919; Walnut Creek: Byte Shop, 2989 N. Main, (415)933-6252. CO: Boulder: Byte Shop, 3101 Walnut, (303) 449-6233. FL: Ft. Lauderdale: Byte Shop, 1044 E. Oakland Pk., (305)561-2983; Miami: Byte Shop, 7825 Bird, (305)264-2983; Tampa: Microcomputer Systems, 144 So. Dale Mabry, (813)879-4301. GA: Atlanta: Computer Mart, 5091-B Buford, (404)455-0647. IL: Champaign: Computer Co., 318 N. Neil, (217)359-5883; Numbers Racket, 623 1/2 S. Wright, (217)352-5435; Evanston: itty bitty machine co, 1322 Chicago, (312)328-6800; Lombard: itty bitty machine co, 42 W. Roosevelt, (312)620-5808. IN: Bloomington: Data Domain, 406 S. College, (812) 334-3607; Indianapolis: Data Domain, 7027 N. Michigan, (317)251-3139. IA: Davenport: Computer Store, 4128 Brady, (319)386-3330. KY: Louisville: Data Domain, 3028 Hunsinger, (502)456-5242. MI: Ann Arbor: Computer Store, 310 E. Washington, (313)995-7616; Troy: General Computer Store, 2011 Livernois, (313) 362-0022. MN: Minneapolis: Computer Depot, 3515 W. 70th, (612)927-5601. NJ: Hoboken: Computer Works, 20 Hudson Pl., (201)420-1644; Iselin: Computer Mart, 501 Rt. 27, (201)283-0600. NY: New York: Computer Mart, 118 Madison, (212)686-7923; White Plains: Computer Corner, 200 Hamilton, (914)949-3282. NC: Raleigh: ROMs 'N' RAMs, Crabtree Valley Mall, (919) 781-0003. OH: Columbus: Byte Shop, 2432 Chester, (614)486-7761; Dayton: Computer Mart, 2665 S. Dixie, (513)296-1248. OR: Beaverton: Byte Shop, 3482 SW Cedar Hills, (503)644-2686; Eugene: Real Oregon Computer Co., 205 W. 10th, (503)484-1040; Portland: Byte Shop, 2033 SW 4th Ave., (503)223-3496. RI: Warwick: Computer Power, M24 Airport Mall, 1800 Post Rd., (401)738-4477. SC: Columbia: Byte Shop, 2018 Green, (803)771-7824. TN: Kingsport: Microproducts & Systems, 2307 E. Center, (615)245-8081. TX: Arlington: Computer Port, 926 N. Collins, (817)469-1502; Houston: Computertex, 2300 Richmond, (713)526-3456; Interactive Computers, 7646 1/2 Dashwood, (713)772-5257; Lubbock: Neighborhood Computer Store, 4902-34th St., (806)797-1468; Richardson: Micro Store, 634 So. Central Expwy., (214)231-1096. VA: McLean: Computer Systems Store, 1984 Chain Bridge, (703)821-8333; Virginia Beach: Home Computer Center, 2927 Va. Beach Blvd., (804)340-1977. WA: Bellevue: Byte Shop, 14701 NE 20th, (206)746-0651; Seattle: Retail Computer Store, 410 NE 72nd, (206)524-4101. WI: Madison: Computer Store, 1863 Monroe, (608)255-5552; Milwaukee: Computer Store, 6916 W. North, (414)259-9140. D.C.: Georgetown Computer Store, 3286 M St. NW, (203)362-2127. CANADA: Ottawa: Ont: Trintronics, 160 Elgin, (613)236-7767; Toronto, Ont: Computer Mart, 1543 Bayview, (416) 484-9708; First Canadian Computer Store, 44 Eglinton Ave. W., (416)482-8080; Computer Place, 186 Queen St. W., (416)598-0262; Vancouver, B.C.: Basic Computer Group, 1438 E. 8th, (604)736-7474; Pacific Computer Store, 4509 Rupert, (604)438-3282.

Processor Technology





# Seven points to consider before you buy your small computer.

In this magazine, alone, there are probably a dozen ads for small computers. New companies are breaking ground like spring flowers.

How, then, do you determine which computer offers the features you need most...at the price you can afford?

We'd like to propose seven basic questions to help you make an intelligent decision.

## 1. How complete is the computer system?

Many buyers of small computers are in for a rude awakening when they have to spend additional money for interfaces.

The Sol-20 Terminal Computer was the first *complete* small computer system. Everything you need to make it work is included in the basic package.

## 2. Is powerful system software available?

It won't do if your system is "tongue-tied."

Processor Technology Corporation has devoted more effort to the development of software than any other small computer maker. Our latest offering is the first fully implemented disk operating system for a small computer: PTDOS. It contains over 40 major commands, several languages and numerous utilities. Our high level languages include Extended BASIC, Assembler, FORTRAN\*, FOCAL and PILOT\*.

## 3. Is the system easy to expand?

More and more computer owners are expanding their small computers to handle business and other specialized requirements.

The largest Sol system can handle 64K bytes of RAM memory and operate with a three megabyte on-line disk memory. Sol systems use the S-100 Bus. So you can use a wide variety of hardware.

\*Available soon.

## 4. Is the computer well-engineered?

Our Sol systems are the most conservatively rated and ruggedly built in the industry, period. In addition we designed them with you, the user, in mind; Sols are easy to build and a joy to operate.

## 5. Does it have proven reliability?

What is the track record? There are over 5,000 Sol systems in the field. Our track record for reliable performance is unparalleled in the small computer field.

## 6. Does it have good factory support?

A computer is a complex piece of hardware. So you want to be sure it is backed up with complete manuals, drawings and a factory support team that cares.

Processor Technology offers the most extensive documentation of any small computer manufacturer. And we maintain a patient, competent telephone staff to answer your questions.

## 7. Are maintenance and service people accessible?

Where are they located?

Processor Technology has maintenance and service people in over 50 cities around the U.S.

As you continue turning the pages, see how we stack up to the other computers in this magazine. If we've succeeded in whetting your appetite, see your Sol dealer or write for information on the complete family of Sol computers.

Processor Technology Corporation, Box G,  
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(415) 829-2600.

**Processor Technology**



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#### Byte Shop of Long Beach

5453 E. Stearns, Long Beach 90815 213-597-7771

#### Byte Shop of San Diego

8250-H Vickers, San Diego 92111 714-565-8008

#### Byte Shop of San Rafael

509 Francisco Blvd., San Rafael 94901 415-457-9311

#### Byte Shop of Tustin

674 El Camino, Tustin 92680 714-731-1686

#### The Computer Store

820 Broadway, Santa Monica 90401 213-451-0713

#### Computer Store of S.F.

1093 Mission St., San Francisco 94133 415-431-0640

### COLORADO

#### Byte Shop

3101 Walnut St., Boulder 80301 303-444-6550

### FLORIDA

#### Byte Shop

7825 Bird Rd., Miami 33155 305-264-2983

#### The Computer Store

2121 Corporate Sq. Blvd., Jacksonville 32216

904-725-8158

#### Micro-Tech Services

3811 N.W. 38th St., Gainesville 32601 904-376-2371

### ILLINOIS

#### Computer Land

9511 Milwaukee Ave., Niles 60648 312-967-1714

### INDIANA

#### Computers Unlimited

7724 E. 89th St., Indianapolis 46256 317-849-6505

### KENTUCKY

#### Data Domain

506 1/2 Euclid Ave., Lexington 40502 606-269-6902

### MASSACHUSETTS

#### Computer Shop

288 Norfolk, Cambridge 02139 617-661-2670

### MISSOURI

#### Micro-Com, Inc.

6314 Brookside Plaza, Kansas City 64113

816-333-8383

### NEW HAMPSHIRE

#### Computer Mart

170 Main St., Nashua 03060 603-883-2386

### NEW YORK

#### Computer Microsystems

1311 Northern Blvd., Manhasset 11030

516-627-3640

#### Data Flow

908 E. Oakwood, Rome 13440 315-337-0601

### NORTH CAROLINA

#### Alpha Digital Systems

Rte. 4, Box 171A, Boone 28607 704-264-7946

#### Byte Shop of Raleigh

1213 Hillsborough, Raleigh 27605 919-833-0210

### TEXAS

#### ComputerCraft, Inc.

3211 Fondren, Houston 77063 713-977-0664

#### Neighborhood Computer Store

4902 34th St., #20, Lubbock 79410 806-797-1468

### WISCONSIN

#### Computer Systems Technologies

312 E. Wisconsin Ave., Milwaukee 53202

414-276-8376

## MICROMATION

524 Union Street  
San Francisco, CA 94133  
415-398-0289

# CALENDAR

Apr 1 Oklahoma Computer Club will be meeting at the Belle Aisle Library at 10 A.M. Call Al Campbell at (405) 842-4933 for details.

Apr 1 Louisville Area Computer Club (LACE) will meet at the University of Louisville, Speed School Auditorium at 1 P.M. For details, write the club at 115 Edgemont Dr., New Alban, IN 47150.

Apr 1 The Computer Hobbyist Group, will meet at 1 P.M. in Green Center, Room 2.530, campus of University of Texas, Dallas. For further information write the club at P.O. Box 11344, Grand Prairie, TX 75051.

Apr 1 South Central Kansas Amateur Computer Association, 9:00 A.M., Wichita Public Library, Wichita, KS. For further information call Chris Borger at (316) 265-1120 or Dave Rawson, 1825 Gary, Wichita, KS 67219, (316) 744-1629 for further details.

Apr 1 Southern Nevada Personal Computing Society will meet at Clark County Community College, Las Vegas, NV at 12:00. The club also meets on the third Saturday of the month. For further information write SNPCS, 1405 Lucille St., Las Vegas, NV 89101 or call (702) 642-0212.

Apr 1 Milwaukee Area Computer Club will meet at 1 P.M. at the Waukesha County Technical Institute, New Berlin, WI. Call (414) 246-6634 for further details.

Apr 3 Minnesota Computer Society will meet at the Brown Institute, Room 51, 3123 E. Lake Street, Minneapolis, MN. For further information contact the Society at Box 35317, Minneapolis, MN 55435, Attn: Jean Rice.

Apr 4 Tidewater Computer Club will hold its meeting at the Electronics Computer Programming Institute, Janaf Office Bldg., Janaf Shopping Center in Norfolk. The club also meets on the third Tuesday of the month. For further information contact: C. Dawson Yeomans, Interface Chairman, 677 Lord Dunmore Dr., Virginia Beach, VA 23462.

Apr 5 The Valley Computer Club will meet at 7 P.M. at the Harvard School located at 3700 Coldwater Canyon, Studio City, CA.

Apr 5 New England Computer Society will meet in the cafeteria of the MITRE Corp. at 7:00 P.M. Located on Route 62 in Bedford, MA. Contact Dave Day at (603) 434-4239 for details.

Apr 5 Kitchener Waterloo Micro-computer Club will meet at the University of Waterloo, Room 3388, Engineering Bldg. #4, University Ave., Waterloo, Ontario, Canada at 7:30 P.M.

Apr 5 Northwest Computer Society will meet in the Pacific Science Center in Seattle, Room 200 at 7:30 P.M. For more details write NCCN, Box 242, Renton, WA 98055.

Apr 5 Lincoln Computer Club will hold its meeting at the South Branch Library located on 27th and South Sts. at 7 P.M. For more details write Hubert Paulson, Jr., 422 Dale Dr., Lincoln, NE 68510.

Apr 5 Amateur Computer Society of Columbus will meet the first Wednesday of each month at the Center of Science and Industry at 7:30 P.M. For further information write c/o Fred Hatfield K8VDU, Computer Data Systems, 1372 Grandview Ave., Columbus, OH 43212, or call (614) 488-3347.

Apr 6 Bay Area Microprocessors Users Group (BAMUG) will meet in the Hayward ROC Center, 26316 Hesperian Blvd., Hayward, CA at 7:30 P.M. For further details write BAMUG, 1211 Santa Clara Avenue, Alameda, CA 94501.

Apr 7 Crescent City Computer Club will hold its meeting at the University of New Orleans, Lakefront Campus at 8 P.M. Call Bob Latham at (504) 722-6321 for more details.

Apr 8 The Permian Basin Computer Group — Odessa Chapter meets at 1 P.M. in the Electronic Technology Bldg., Room 203 on the Odessa College campus. For details call (915) 332-9151.

Apr 9 North Orange County Computer Club will have its meeting at Chapman College, Orange, CA. Doors open at 12:00. 105 Hashinger Hall Auditorium. Membership Chairman, Tracey Lerocker, (714) 998-9722 evenings.

Apr 12 Homebrew Computer Club meeting will begin at 7 P.M. in Menlo Park, CA at the Stanford Linear Accelerator Center Auditorium. Call (415) 967-6754 for more details.

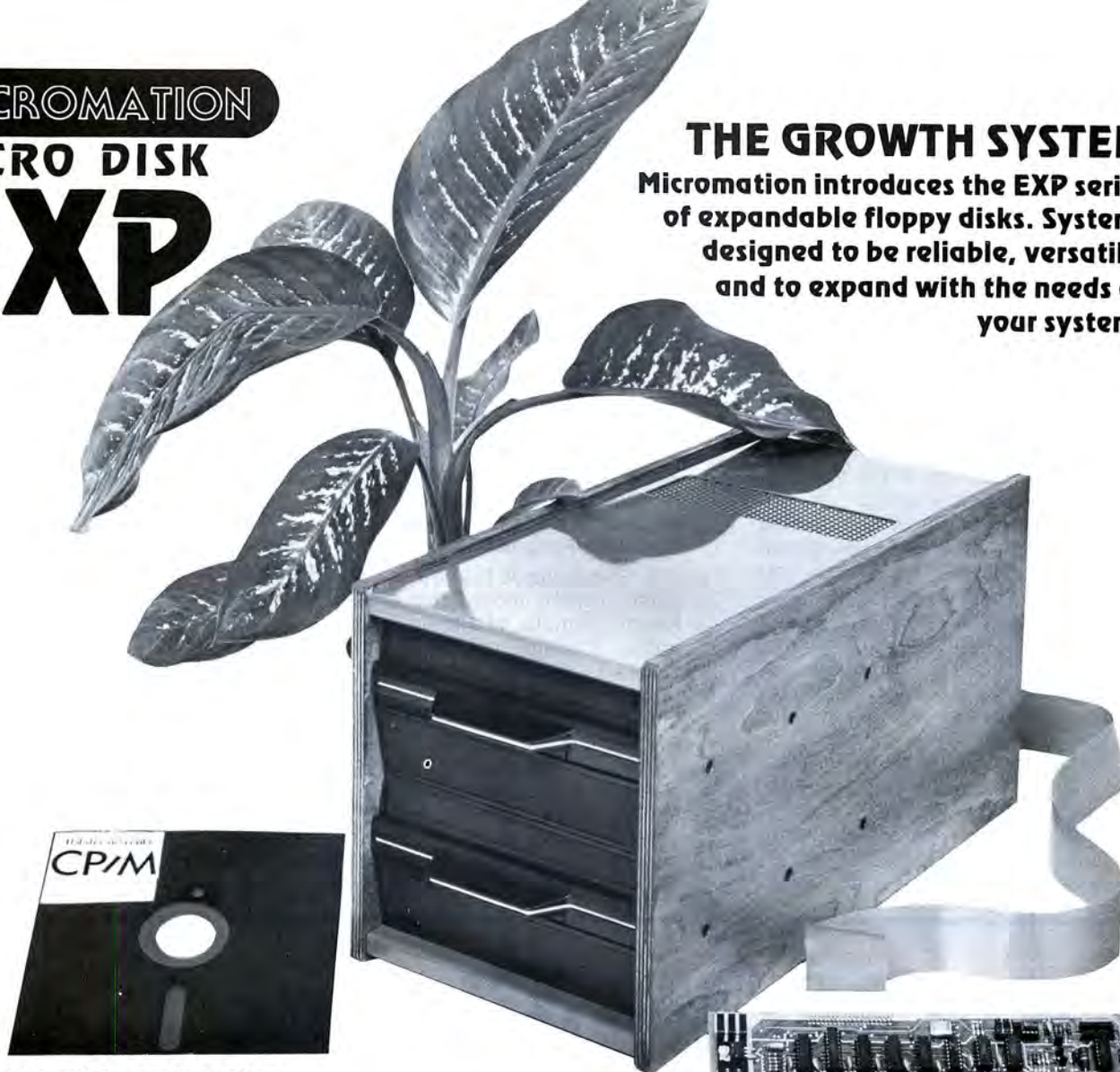
Apr 13 Mid America Computer Hobbyist meeting will be at 7:00 P.M. at Commercial Federal Savings & Loan, Bellevue NE. Intersection of Galvin Rd. and U.S. Hwy. 73-75. Write P.O. Box 13303, Omaha, NE 68113 for further information.

Apr 13 Utah Computer Association will meet at Murray High School,



# MICROMATION MACRO DISK EXP

**THE GROWTH SYSTEM**  
Micromation introduces the EXP series of expandable floppy disks. Systems designed to be reliable, versatile, and to expand with the needs of your system.



## STEP UP TO DOUBLE-HEADED

New double-headed drives record data on both sides of a diskette — But no manufacturer is delivering them yet. When these new double-headed drives become available, single headed drives will be obsolete—except for the EXP series. Because Micromation guarantees to exchange any EXP series single-headed drive for a double-headed drive—at a cost of only \$300 per drive.

You can also upgrade your system to double density in the third quarter with our double density controller conversion for only \$300.

So the dual drive system that you buy now has a capacity of over 500 K Bytes, but can be increased to a capacity of two megabytes. Your system will grow with new technology—not be obsoleted by it.

## SOLID SOFTWARE SUPPORT

The Micromation disk controller features IBM 3740 compatibility—and the proven CP/M\* operating system. You can also choose between high level languages such as BASIC AND FORTRAN or complete business application and word processing packages.

## A COMPLETE, ASSEMBLED SYSTEM

All Micromation systems are fully assembled and tested. There's even a serial I/O port on the controller to make it easy to bring the system up. Just connect your terminal to the serial port, install in any 16K S-100 system, jump to the on-board PROM bootstrap—and you're up and running without any patching. Or you can choose optional I/O drivers for the SOL computer.

EXP systems are complete—including drives, S-100 controller, power supply, and handsome Scandinavian style wood and metal enclosure.

## RELIABILITY

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Rm 154, 5440 S. State St., Salt Lake City, UT at 7 P.M. For details write or call Larry or Holly Barney, 1928 S. 2600 E., Salt Lake City, UT 84108. (801) 485-3476.

Apr 13 The Rochester Area Microcomputer Society will meet at the RIT Campus, Rm. 1030, Bldg. 9 at 7:30 P.M. For details write RAMS, P.O. Box D, Rochester, NY 14609.

Apr 13 North Florida Computer Society will meet at 227 Edison Dr., Pensacola, FL 32505. For information write this address or call Eugene Rhodes at (904) 453-3844.

Apr 14 Northern New Jersey Amateur Computer Club (NNJACC) will hold its meeting at the Fairleigh Dickenson University, on the Rutherford Campus, Becton Hall, Room B8, at 7 P.M. For details write NNJACC, 593 New York Ave., Lyndhurst, NJ 07071.

Apr 15 Southern Nevada Personal Computing Society will meet at Clark County Community College, Las Vegas, NV at 12:00. The club also meets on the first Saturday of the month. For further information write SNPCS, 1405 Lucille St., Las Vegas, NV 89101 or call (702) 642-0212.

Apr 15 San Diego Computer Society will meet at the Grossmont Community College Student Center,

8800 Grossmont College Dr., El Cajon, CA. Doors open at 12:30. For details call (714) 565-1738.

Apr 15 The 7C's Committee (Affiliated with the Cleveland Digital Group) will meet at Cleveland State University Student Services Bldg., in the Kiva Room at 2:00 P.M. For more information write to Cleveland Digital Group, 8700 Harvard Ave., Cleveland, OH 44105.

Apr 15 Central Florida Computer Club will meet at the Orlando Utility Bldg., on S. Orange Ave., Orlando, FL at 2:00 P.M.

Apr 15 Philadelphia Area Computer Society will meet at 2 PM at LaSalle College Science Bldg. at the corner of 20th & Olney Ave. For more details write PACS, P.O. Box 1954, Philadelphia, PA 19105.

Apr 18 Rhode Island Computer Hobbyists (RICH) meets the at the Knight Campus of Rhode Island Junior College in the Faculty Cafeteria at 7:30 P.M. For further information contact Emilio Iannucillo, RICH, P.O. Box 559, Bristol, RI 02809, or call (401) 253-5450.

Apr 18 Sacramento Microcomputer Users Group, (SMUG), 7:30-9:30 P.M. at SMUD Training Bldg., on 59 St. Write Richard Lerseth, P.O. Box 161513 or call (916) 381-0335 after 5:00 P.M.

Apr 18 Tidewater Computer Club will hold its meeting at the Electronics Computer Programming Institute, Janaf Office Bldg., Janaf Shopping Center in Norfolk. The club also meets on the first Tuesday of the month. For further information contact: C. Dawson Yeomans, Interface Chairman, 677 Lord Dunmore Dr., Virginia Beach, VA 23462.

Apr 21 Long Island Computer Association will meet at 7 PM at the New York Institute of Technology, Old Westbury Campus, Route 25A between Route 107 and Glen Cove Rd., Rm. 508. For more details write Long Island Computer Association, 36 Irene Lane East, Plainview, NY 11803.

Apr 21 Amateur Computer Group of New Jersey (ACGNJ) will meet at UCTI, 1776 Raritan Rd., Scotch Plains, NJ 07076 at 7 P.M. For further information write to the club at the above address.

Apr 23 Summit City Computer Club will meet at the McMillen Library on the Indiana Institute of Technology Campus in Ft. Wayne, IN. For details write the club at P.O. Box 5096, Ft. Wayne, IN 46805.

Apr 23 Birmingham Microprocessor Group will meet at Southcentral Bell Company headquarters bldg.

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Apr 25 Computer Amateurs of South Jersey will hold its meeting at the National Park Municipal Bldg., 7 So. Grove Ave., National Park, NJ at 7:30 P.M. For details call (609) 541-1010, or (609) 541-8296.

Apr 26 Ventura County Computer Society will meet at Camarillo Public Library, 3100 Ponderosa Dr., Port Hueneme, CA 93041 at 7:30 P.M. For more information write: VCCS, P.O. Box 525, Port Hueneme, CA 93041.

Apr 26 Boston Computer Society will meet at the Commonwealth School, 151 Commonwealth Ave., Boston at 7 P.M. The school is located on the corner of Dartmouth St. in Boston's Back Bay. For information write or call the society at 17 Chestnut St., Boston, MA 02108, (617) 227-1399.

Apr 26 Diablo Professional Users Group (DPUG) will meet at Diablo Valley College Library, near the Willow Pass exit of Fwy. 680, from 8-10 PM. For details write or call Bob Hendrickson, Electronics Dept., DVC, Pleasant Hill, CA 94523; (415) 687-8373.

Apr 27 Space Coast Microcomputer

Club will hold its meeting at 7:30 P.M. at the Merritt Island Library, Merritt Is., FL. Contact Ray Lockwood at (305) 452-2159 for details.

Apr 27 Small Computer Engineering Association of Minnesota (SCEAM) will meet at the Resource Access Center, 3010 Fourth Ave. So., Minneapolis, MN 55408 at 7 P.M. For more information write to this address or call (612) 824-6406.

Apr 28 TRACE will hold its meeting at the Ontario Science Center, 8 P.M., 770 Don Mills Road, Don Mills, Ontario. Club address is Box 545, Streetsville, Ontario, Canada L5M 2C1.

Apr 28 Alamo Computer Enthusiast meets at 7:30 P.M. in Room 104 at Chapman Graduate Center at Trinity University, San Antonio, TX. For details call (512) 532-2340, or write to the club at 7517 Jonquill, San Antonio, TX 78233.

Apr 28 Washington Amateur Computer Society has scheduled its meeting to be held at the Catholic University of America, St. Johns Hall. Located at Michigan and Harewood Aves. in Washington, D.C. Contact Bill Stewart at (202) 722-0210 for club details between the hours of 10 A.M. and 12 P.M.

Apr 28 University of Minnesota Microcomputer Users Group

(UMMUG) will hold its meeting at the University of Minnesota, Electrical Eng. Rm. 115 at 7 P.M. For further information write UMMUG, Dept. of Elec. Eng., 123 Church St. S.E., Minneapolis, MN 55455.



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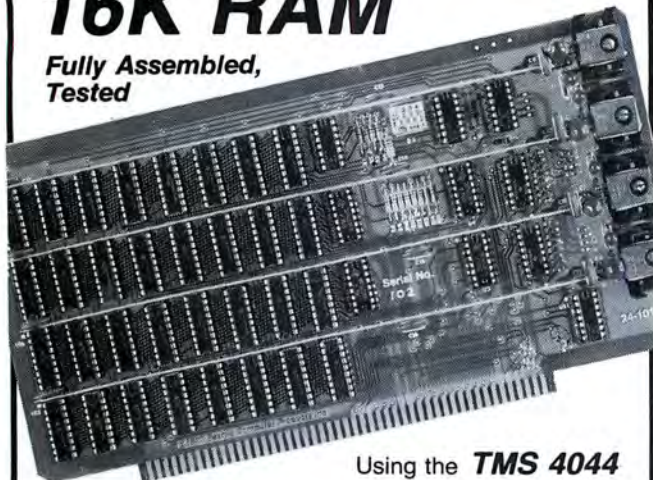
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# WHITE COLLAR MICROCOMPUTER

By James S. White

Which types of hardware are key to an effective business microcomputer? You know a computer is for you, or at least you want to seriously look at the possibility. You have good ideas how you might use a computer to help in your business or other professional work. And you are aware of the importance of some of the total system characteristics discussed last month in this column; hardware you can easily use with little preparation, competent maintenance service, appropriate and functional software, and education which is meaningful for you.

Now you are interested in some understanding of the hardware itself. What, you wonder, are the hardware peripheral components that make a computer suitable for you, the business user? How does the typical hardware available today, which is fine for the hobbyist, student, or other home user, differ from the hardware that should be part of a system appropriate for professional use? Which of the many differences should a prospective buyer especially evaluate?

First, for background, let's review some characteristics of the business system market. At today's wage and benefit rates, even small amounts of a working person's time are expensive, compared to the cost of many computing equipment alternatives, or at least when compared to the typical rate of pay received for the typical home or hobby computer user. Therefore, appropriate equipment is that which includes the most features that today's technological state-of-the-art can cost-effectively provide. Such features include: Rapid operation of those components important to providing results with little delay, and design features which allow the computer system to do a given job while needing relatively little human support time.

System accuracy is also very important because correcting computer errors can be very expensive. Just as a computer can, in one minute, do a week's worth of clerical work, a computer can, in one minute, foul things up so badly that a week's work by a clerk will be required to correct them.

Further, certain features appropriate for hobbyists' systems may be missing in business systems. These may be features which make the equipment easy to modify or to use for lots of types of tasks. Other hobbyist features are those which make equipment repairable at a component level. Hobbyists want to repair by spending 2 hours using a 25¢ part; many businessmen would rather spend 10 minutes and use a \$15 module. Similarly, most of the game and recreation features which generate consumer sales volume today are only impediments for the business user.

## PRINTER

The primary distinguishing characteristic of a business system, for most applications, is that it includes a printer. Cost is the primary reason that printers are not common on all types of systems; their typical price of between \$700 and \$2500 equals the cost of most complete hobby or home systems. Even the under \$200 cost of the minimum-capability kit is high for the user who must also invest the time and parts to make the printer an operational part of his system. Maintenance is also a



significant cost factor for the printer user, particularly when contrasted with the electronic components, with no moving parts, comprising most of a computer system.

Businesses, being different from the recreational computer user, need permanent records, particularly in this day of government regulation and audit. Businesses must also communicate with customers and suppliers. Such people generally work best with information they can see and hold—employees want paychecks and deduction records, as do suppliers, who also should receive written purchase orders. Customers want written quotations, order acknowledgments, delivery promises, packing lists, invoices, and statements-of-account. The business itself needs internal audit trails for complex calculations and derived records. All these, and more, can be produced by a comprehensive business system consisting of data, programs, and appropriate hardware, including a printer.

As a philosophical consideration, printers aren't essential, and society is moving away from its dependence on paper. Electronic funds transfer, credit card billings without receipts, the use of microfilm, and the replacement of popular magazines by TV are all small steps in that direction. But most people and businesses today aren't ready to give up paper, even though, compared to a good computer system, paper is quite inefficient for many applications. Giving up paper is simply more of a change in thinking and operating procedure than most people are willing to make. Even the printed internal audit trail is needed; primarily because most users aren't ready to accept as solely conclusive EDP system storage and protection of detailed audit trail data readily accessible and meaningfully presented on request.

An alternative to paper is manual writing of data from a video screen. However, in most businesses, this isn't economically realistic. For them, a good computer system is one which can do the complete job. It shouldn't need a person to transcribe its output to the desired end result.

The slowest microcomputer printers, at 10 characters per second, may seem very fast unless you are waiting for results. Computers supporting large businesses use printers which can output, for example, 1100 lines of 132 characters per minute, or more than 2400 characters per second. Many are even faster. Present technology, as applied to low cost microcomputers, gives up to 160 characters per second, which is generally quite satisfactory for the microcomputer dedicated to one or a few applications.

Many types of printers are available. Variables significant to users include the number of characters per line that can be printed (generally 40 to 132), the different number of characters that can be printed (sometimes not including lower case letters), the appearance and legibility of printing, the number of carbon copies (up to 8 on some printers) possible, and the type(s) of paper that can or must be used. Some printers require expensive, specially coated paper, some can print on standard forms and letterheads, some can print on normal continuous forms for long unattended system operation. Selection criteria must be based on individual applications.

The wide variety of printers available, and the fact that various types can be attached rather easily to many computer systems (often via commercial video terminals) gives the user significant flexibility in assembling his optimum system. Although the computing-novice user can benefit from selecting from various equipment and vendor options, a prudent approach is, as part of the purchase package, to require the vendor to attach the printer to the system and make it totally operational.

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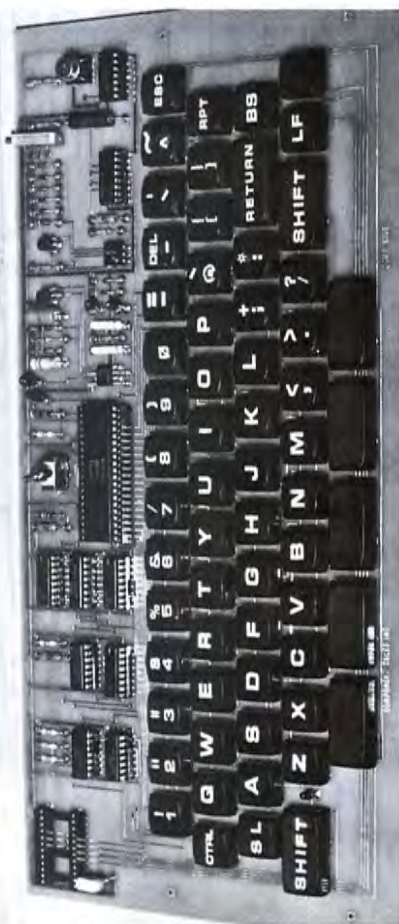
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## KEYBOARD

The most labor-intensive, and thus most expensive, part of business computing is often data entry—the operations that convert human-sensible data into machine-sensible data. The device typically used today is a keyboard.

A keyboard's primary purpose in a business environment is to allow accurate manual entry of data at the lowest possible cost. To do this, the keyboard should be "human-engineered"—easy to use, with existing skills, for present personnel or personnel likely to be hired. It should also be suitable for speed keying and, to the extent practical, be pleasant for the operator to use. Keyboards with response characteristics adjustable to the operator's preference are optimum in this regard.

A numeric keypad is important for applications requiring entry of large volumes of numeric data. This is a feature missing on most hobbyist systems, and even on some keyboards marketed for professional use. A numeric keypad is a rectangular group of keys arranged similar to the digit keys on a calculator. Optional numeric keypads are sometimes available with the digits arranged the same as on keypunches, and are probably appropriate only for operators whose experience is primarily keypunch. Numeric keypads, whatever the arrangement of digits, generally are separate keys to the right of the main alphanumeric keys. Sometimes, however, the numeric keypad is a rectangular group of several of the same keys as used for entering alphabetic data—the numeric option of these keys is activated by the shift key.

In addition to being easy to use, a keyboard must remain operational. Because a keyboard has many moving parts, problems are likely. On some systems, the keyboard gives the most problems of this type. Having a maintenance contract covering the keyboard somewhat minimizes the significance of this consideration, but a maintenance contract doesn't eliminate the problems of having the keyboard, and the attached computer, not available between the time it quits working and the time it is fixed. Other pertinent considerations are the cost and method of repair suitable for a particular type of keyboard. On some, individual keys can be replaced. For others, the most economic approach is to replace the entire keyboard.

Keyboards for business systems are generally packaged as part of a video display terminal. A useful characteristic offered on some terminals is a physically separable keyboard, which can be moved to any position comfortable for the user's hands, while the video screen remains positioned for easy viewing.

The most common commercial keyboard and video display work station is the Lear Siegler ADM-3A (for American Dream Machine), often sold with other vendor's nameplates. Lear Siegler's ADM-1A is similar but also includes, as standard, a numeric keypad and several control features. The Beehive B-100 is another terminal included as part of various system manufacturer's products. Hazeltine terminals are popular for use on larger computers, but are also well suited for microcomputers; the models 1000 and 1200 are frequently available in used condition and have been replaced by the 1500 series. Several other manufacturers produce high quality, well accepted terminals.

In the future, new keyboard and electronic technology may bring considerably changed products and capabilities to this area where designs presently only imitate mechanical devices. The Writehandler<sup>TM</sup>, introduced in the January issue of INTERFACE AGE, may be a good example of the possibilities.

There are many ways to enter data to a computer, other than passing it through the expensive, often ineffi-



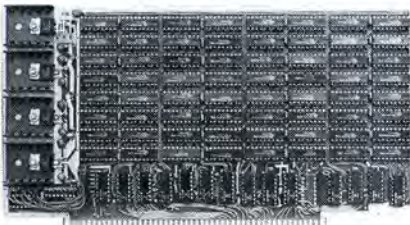
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cient, human keyboard operator. This is one of technology's areas of greatest potential. However, to date, there has been only limited success in developing and producing a product that can match the versatility provided by even the marginally motivated human operator.

## FLOPPY DISKS

Today's final major characteristic of a professional system is its capability to quickly access any desired data, selected from the very large amounts of data generally part of the records of a business. Commercial applications typically deal with large numbers of customers or clients, inventory items, accounts, and so on. Data is accessed without consistent pattern, and may be presented to a person, used in computation, or changed on disk. For most business applications, this rapid storage and access of data is the reason for a computer. A floppy disk drive generally supplies this mass storage capability, in today's technology, and is likely to be for the next few years. A combination of drive and controller is normally available to the user, and is commonly called a drive. The disks (or diskettes) themselves cost about \$5, resulting in a typical cost of approximately \$30 per million bytes of stored data.

Individual disks can contain at least 80,000 bytes of data. Maximum storage capacity for one of today's microcomputers is usually obtained by attaching four of the new double-density, double side, full size drives, which combination can put any of over 5,000,000 bytes of information into computer processing in a fraction of a second.

Costs of disk device packages including controller and drive start at about \$750, and go to above \$2000, depending on storage capacity, compatibility with various computers, and other features. Other important cost effective variables are: The availability of software, how easy and quick is data storage and retrieval in actual practice, and how quickly and easily the user can write his own programs to store and retrieve data.

## TWO NEW SYSTEMS

IBM has recognized the importance of the small business market and has produced products significantly different than those for the large system user. MITS has changed its entire orientation from the hobbyist to the market it feels is where the action is — business systems.

The marketing approach being taken by IBM and MITS is indicative of the current trend of the industry. Even though this approach has not yet been evaluated by the marketplace, the leadership position alone of these two companies is sure to influence future developments.

### IBM 5110

This new system is similar to the IBM 5100 that has been marketed for the past 2½ years. Both the 5100 and the 5110 are small, personal business computers, intended for data processing, record keeping, and scientific jobs. Purchase prices of both systems start at just under \$10,000, an investment amount quite realistic for many income-producing applications. Both are integrally packaged, so most parts are in one case, a feature which adds versatility because these computers can easily be moved to various locations; to handle various types of applications.

Perhaps the most dramatic change in the 5110, as compared to the 5100, is the addition of floppy disk memory. The on-line (immediately accessible), data storage capacity of the 5110 can be up to 4.8 million bytes, a limit similar to most other microcomputers.

The older 5100 system uses magnetic tape cartridges for large (200K bytes per cartridge) volume storage. Although this media is available on one model of the new 5110, IBM is clearly joining the remainder of the industry in moving towards floppy disk random access as

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a de facto standard, and away from magnetic tape sequential processing. Tape cassettes still seem to have a future, for applications where very low cost is important.

Another major 5110 development is the addition of communications capabilities. The new computer can transmit and receive data or programs to and from most IBM computers. The 5110 floppy disks are also compatible with other IBM systems, so they can be used as a method of interchanging information. This concept of giving microcomputers the capabilities of optionally, operating on their own, or in conjunction with other systems, is a significant step towards optimizing the useability of all computing resources and furnishing computer power in the way and place it can best be used.

IBM hasn't forgotten software either, although 5110 software is relatively (for IBM) weak, as is typical in today's microcomputer industry. BASIC and APL, supplied in ROM (read only memory chips), are somewhat improved over the 5100 versions. The new BASIC language includes picture formatting, an important feature for commercial programs, which provides, for example, floating dollar signs and commas. A hardware sort feature allows many control field options.

New commercial application packages include general ledger, accounts payable, and report creation. At costs of \$600 to \$900 each, these three software systems could be a bargain for the business user whose alternative was to write his own programs.

### MIT S 300

This family of systems is similar in price (starting at under \$12,000) and principal storage media, (floppy disk), to the IBM 5110. However, it is more expandable, being able to be built up to include capabilities IBM provides only with its larger System 34.

A large MITS 300 system features a hard (not floppy) platter disk drive, which can hold up to 10 million bytes of data. Half of this storage capacity is on a removable disk pack or cartridge, thus several packs can be interchanged for various applications. Prices of a MITS system including hard disk start at about \$16,000, providing a very affordable system for the commercial application needing its power.

The largest MITS 300 system can have over 50 million bytes of on-line data, filling the needs of almost any small business. This is a system with considerable data processing power, comparable to that of many traditional computer systems. As such, this "microcomputer" could well serve many medium size businesses.

The central processing unit for each of these systems is the MITS 8800b, which illustrates two points. First, the potential power of a microcomputer is considerably beyond what most businesses will use for a long time, probably until today's microcomputers are technically obsolete. Second, the cost of a system, and its important capabilities, although determined somewhat by the central processor, are determined much more by other parts and factors.

The MITS 300 normally includes a video display unit, of a type commonly used on several other computer systems. Also included is a 60-character per second printer, controlled by electronic logic.

Software support is presently rather weak. The BASIC language and disk operating system are available. MITS also furnishes a reasonably comprehensive accounting package. Of course, many BASIC and 8080 programs are available from libraries and software vendors, but without the system manufacturer's support.

Important dealer support of users will be offered through almost 50 stores. MITS will also encourage original equipment manufacturer marketing. Hardware repair will also be available through the stores and Per-tec Computer Corporation, the new owner of MITS, ser-

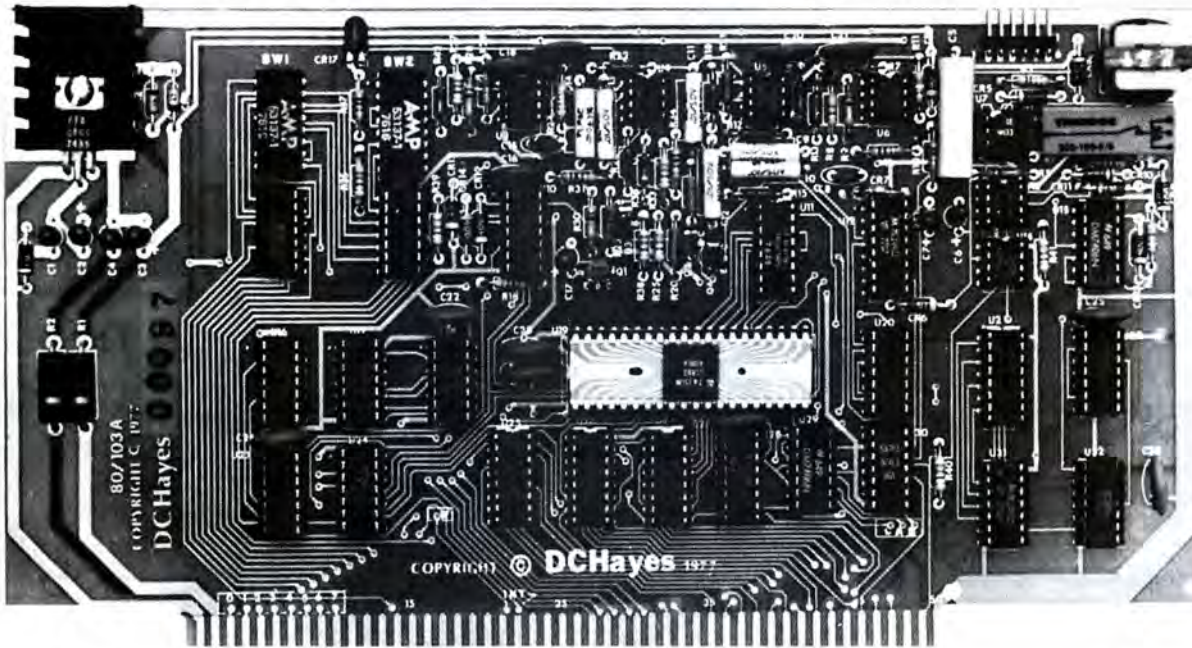
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# INTERFACE AGE™

## Authors' / Cartoonists' Style Guide

*The preparation of an article for publication requires that some very definite steps be followed. Therefore, to help you as an author or artist, we have prepared this style guide.*

*This style guide is divided into nine sections. Each section is designed to convey specific information regarding submitting material to INTERFACE AGE Magazine. It is our intent that this guide be used as a helpful tool by prospective authors and artists.*

**Robert S. Jones, Publisher/Editor-in-Chief**

### PREPARING AN ARTICLE

Starting with the basics, what should you write about? What do you know? You may be saying to yourself, "not much." Okay, but what were you just explaining to your friend in the computer club? Was it a chess program, a method of soldering without burning your fingers, a method of converting octal to binary, or...? Any of these ideas can be turned into a useful and informative article.

Another good source of ideas are the magazines themselves. Pick out ten interesting articles and ask yourself the following questions about each one: Can I write an article like this? What did the author omit? What can be expanded? Can it be written at a higher technical level? A lower technical level? Can it be written from a different viewpoint?

Once you have your idea, you are ready to start writing. Follow these 12 steps:

1. Make a list of topics and ideas.
2. Write a rough outline.
3. Write a good outline.
4. Write a rough draft.
5. Revise the rough draft.
6. Write the second draft.
7. Do a line by line revision.
8. Write and type the final draft.
9. Edit and revise.
10. Do a line by line revision.
11. Retype and proof the final draft.
12. Retype (if necessary); insert photographs, drawings and printouts. Submit it to the magazine.

Why do you need an outline? Mainly, because it helps consolidate your thinking. Every article should have a structural design that allows you to emphasize your most important points and relate these points to one another. It also has a beginning, a middle and an end. The middle is further divided into a number of separate sections so carefully put together that each paragraph fits into only one place.

Once you have a good outline, you are ready to start your rough draft. You can either keep your outline on hand for reference, or you can read it and put it aside. Putting it aside is usually the best method, but try both.

Your rough draft should be exactly that, rough! Don't try to correct things as you go, just put your thoughts on paper. You should go entirely through a rough draft before you attempt to edit or revise it. This is time-consuming and cumbersome, but it's worth it. Follow a set pattern: write, edit, revise, rewrite. If you follow this pattern your work should hang together. This leads us to the most important part of revising: be *vicious*. Cut out everything that isn't clear, concise and necessary.

Clarity is the primary goal of good writing, so try to organize your thoughts in a logical manner. This can best be done by remembering these rules:

1. Follow your outline.
2. Explain things carefully.

3. Give examples.
4. Be specific.
5. Remember your reader.
6. Include drawings, photographs or programs to amplify your comments.
7. Write short, clear, well-constructed sentences.
8. Restrict each sentence to a single idea.

### FORMAT FOR SUBMITTAL

Manuscripts should be double-spaced, typewritten pages, one inch margins, and not less than three and one-half (3½) pages in length (one published page). Pages should be numbered to insure correct text. Photographs should be numbered and labeled on the backside with a description. Photos should be taken with uniform lighting and background, in the form of glossy black and white prints. Tables, listings, etc. shall be on separate sheets. Computer listings shall be printed using a new ribbon to assure darkest print copy.

Manuscripts submitted for publication must include:

1. Cover letter of author's background.
2. Abstract of article (approximately 100 words).
3. The working outline used to create the article.
4. Body of article.
5. List of any figures, tables, photos and flowcharts. Any captions or credits, pertaining to the art, must also appear on this page.
6. Any figures, photos, tables, or flowcharts. Each must be identified in the same manner they appear on the list.
7. Self-addressed, stamped envelope.

Cartoons should be on white, 8½ x 11 paper. All artwork must be drawn in black ink. Each art piece must be captioned, and numbered on the back.

Cartoons submitted for publication must include:

1. List of all artwork submitted, along with reference numbers.
2. Art pieces, as they appear in order on the list.
3. Self-addressed, stamped envelope.

The publisher assumes no responsibility for artwork, photos, models or manuscripts. **Manuscripts are not acknowledged or returned unless accompanied by an addressed, stamped, return envelope.**

### LINE ART

Line art can consist of flowcharts, block diagrams, schematics or artist's conception of a system. The important point is that to ensure that your article is correctly evaluated and published, the line art must be presented in a formalized manner. Therefore, we offer the following suggestions and guidelines.

Flowcharting is a method of outlining the thought processes, used in developing a piece of software. All software articles submitted to INTERFACE AGE Magazine must have a flowchart included to help in the evaluation by the editors, and understanding by the readers.

Flowcharts must be drawn on graph paper in black ink using American National Standard symbols. Flowcharting aids can be obtained from many bookstores, or from Fickled Thinking Aids.

Schematics are a must when discussing a particular piece of hardware, or when presenting a design for one. Schematics for commercial pieces of equipment can usually be obtained by contacting the manufacturer. Schematics for your own design must be on graph paper

\*As paraphrased from *Principles of Technical Writing*, by Robert Hays, Addison-Wesley Publishing Company, Inc., 1965.



in black ink. ANSI, logic symbols must be used rather than a concept of your own.

Block diagrams fall into the same category as flowcharts and schematics and must also be on graph paper in black ink. Artist's rendering must be complete in total design and color keys supplied.

Although the artwork supplied with a manuscript is redrawn, it is important that you submit the best possible.

## PHOTOS

Photographs must be 8 x 10 black and white glossies, unless the story calls for color. Each photograph must have a number on the back keyed to the list of photos and captions. DO NOT glue or tape the photographs to paper or cardboard. Use cardboard to protect the photos while in the mail.

## COPYRIGHTS AND TRADEMARKS

The unauthorized or careless usage of a copyright or trademark can result in a civil suit for a violation of the copyright or trademark.\*

A trademark is a word or phrase indicating the source of a product, not a generic name of the product.\* Trademarks must be capitalized, spelled and punctuated exactly in the same manner used by the owner. Also the abbreviation TM must appear at the upper right hand corner of the final letter of the trademark.

When you plan to use material under someone else's copyright, it is imperative that you obtain in writing permission to use the material. A copy of this release must accompany any article sent to INTERFACE AGE Magazine.

## PUNCTUATION

Punctuation is used to help the reader understand the written material before him. Punctuation gives hints to the meaning of a sentence. Also, it is used to emphasize and clarify words and statements within the text. The following is a list of some common punctuation marks and their usage:

### 1. THE SEMICOLON

The semicolon is used to separate phrases containing commas. The semicolon is also used to separate statements of contrast and statements that are closely related:

The terminal was inoperative; the computer functioned perfectly.

### 2. THE APOSTROPHE

The apostrophe indicates the possessive case of nouns, omission of figures and contractions:

Mike's house. can't

### 3. THE COLON

The colon precedes the final clause summarizing prior matter; introduces lists, statements and texts. Use the following ideas: eat well, get up early and work late.

### 4. PARENTHESES

Parentheses set off material, or an element of a sentence:

The entire system is made up of four parts, (Figure 1).

### 5. QUOTATION MARKS

Quotation marks enclose direct quotations; around slang; misnomers, titles of books, lectures or speeches:

Bob Jones said: "The computer is a tool to be used for the benefit of all."

"UNITED PRESS INTERNATIONAL STYLEBOOK"

## NUMERALS

There is no definite rule in the writing of numbers; the situations vary too much. Therefore, only some general guidelines can be given: Never begin a sentence with a number, use figures for all decimal numbers, (1.234), use figures for exact numbers, in tables use figures. Within a sentence be consistent in either spelling out numbers or writing them in figures.

The general rule of thumb is to use: Numbers between one and nine spell out. Numbers 10 or greater use figures, (1,024).

## WORD GUIDE

BASIC	PRINT	ROM	RAM
Floppy ROM™	microprocessor	microcomputer	
disk	Figure	nanosecond	
NAND	NOR	OR	AND
LED	VTVM	8080-based	
NPN,PNP	IC		

## RULES OF CAPITALIZATION

Capitalize the letter in a combination of a letter and noun. For words where the letter represents the shape of the object use capitals.

A-frame	I-beam	O-ring	U-tube
C-clamp	J-antenna	S-curve	V-belt
H-beam	L-section	T-square	Y-junction

Use capitals for laws or formulas named for the discoverer:

Ampere's rule	Einstein theory
Barkhausen effect	Faraday effect
Coulomb's law	Kirchhoff's law
Dalton's law	Lambert's law

Do not capitalize words that are used as units:

ampere	galvanic	newton
britannia metal	henry	ohm
coulomb	joule	roentgen
dalton	lambert	statampere
farad	megohm	volt
foot-lambert	millihenry	wheatstone bridge

## COMMON ABBREVIATIONS

absolute.....abs	joule.....j
alternating-current	kilocycles/second.....kc
(as adjective).....a-c	logarithm (common).....log
ampere.....amp	logarithm (natural) .log. or ln
antilogarithm.....antilog	megohm.....spell out
average.....avg	meter.....m
centigram.....cg	meter-kilogram.....m-kg
centimeter.....cm	mho.....spell out
centimeter-gram-second(system) ..cgs	microampere...ma or mu a
coefficient.....coef	microfarad.....mf
cologarithm.....colog	micromicrofarad.....mmf
constant.....const	milliampere.....ma
coulomb.....spell out	millihenry.....mh
counter electromotive force.....cemf	ohm.....spell out or Ω
cubic.....cu	ohm-centimeter...ohm-cm
decibel.....db	root mean square.....rms
inch.....in	square root of mean square.....rms
inch-pound.....in-lb	standard.....std
inches per second...ips	tangent.....tan
kilogram.....kg	thousand.....M
	volt.....v

## REFERENCE SOURCES

The books we are listing below are generally available at most bookstores.

Roget's New Pocket Thesaurus in Dictionary Form by Lewis (Pocket Books)

Look It Up by Rudolf Flesch (Harper & Row)

Webster's New World Dictionary of the American Language (Prentice-Hall)

Microcomputer Dictionary and Guide by Charles J. Sipple and David A. Kidd (Matrix Publishers)

Principles of Technical Writing by Robert Hays (Addison Wesley)

Well, that's about it. Please use outlines and rough drafts. Remember, you can always improve what you've written.□

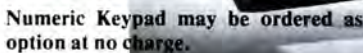
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QTY. IN STOCK	COST	PRICE	QTY. ORDERED	DUE DATE
17	2.75	42.00	50	4/18/78

ENTER PART NUMBER: 0

INTERFACE AGE 33



# ... FROM THE FOUNTAINHEAD

By Adam Osborne



All of you 6800 users, here is a telephone number to write down and save: (713) 823-0877. This is Chuck Adams' number.

Chuck Adams called me and gave me his side of the SWTP BASIC story. According to Chuck, he wrote an ANSI standard BASIC for SWTP. SWTP (and the microcomputer community in general) want an MITS 4.0 compatible BASIC. Chuck claims that he will have an MITS 4.0 compatible BASIC for SWTP 6800 microcomputer systems by the end of January. One thing still missing, however, will be disk-driver routines and disk-drive statements. This is (according to Chuck) because SWTP has not yet completed their disk driver software.

Chuck Adams' BASIC is an 8K extended BASIC. This means that the interpreter occupies 8K bytes of memory. Chuck says a minimum of 12K will be needed. I say you will need 16K, since in my experience you get very little programming done unless you have 8K bytes of usable memory available to you. Chuck Adams' BASIC generates a compressed, pseudo object code — which is what most BASICs do these days. Chuck will ship a few copies of his 8K BASIC to users who are prepared to help him test and debug the software. Ultimately, however, you will have to go to SWTP for this software.

Chuck believes that Microsoft's MITS 4.0 standard BASIC will become the standard for the hobby industry.

The most interesting thing about Chuck Adams and his efforts is the fact that he represents the computer hobby industry at its best. He and his club at Texas A & M are producing large quantities of useful software, their primary goal being to provide other hobbyists with usable tools. With the spirit that Chuck is showing, I suggest that all of you 6800 hobbyists get together behind him.

I recently heard again from Bill Reagan, president of Technico (they make a TMS9900-based kit). Bill reports that he agrees wholeheartedly with my earlier comments regarding European opportunities. In September, Technico started actively marketing their microcomputer kits in Europe; so far they have sold more than 100 systems outside of the U.S.A. Technico is selling all products outside the U.S.A. through Technico International, headquartered in Arlington, VA. Technico International's phone number is (703) 538-4000.

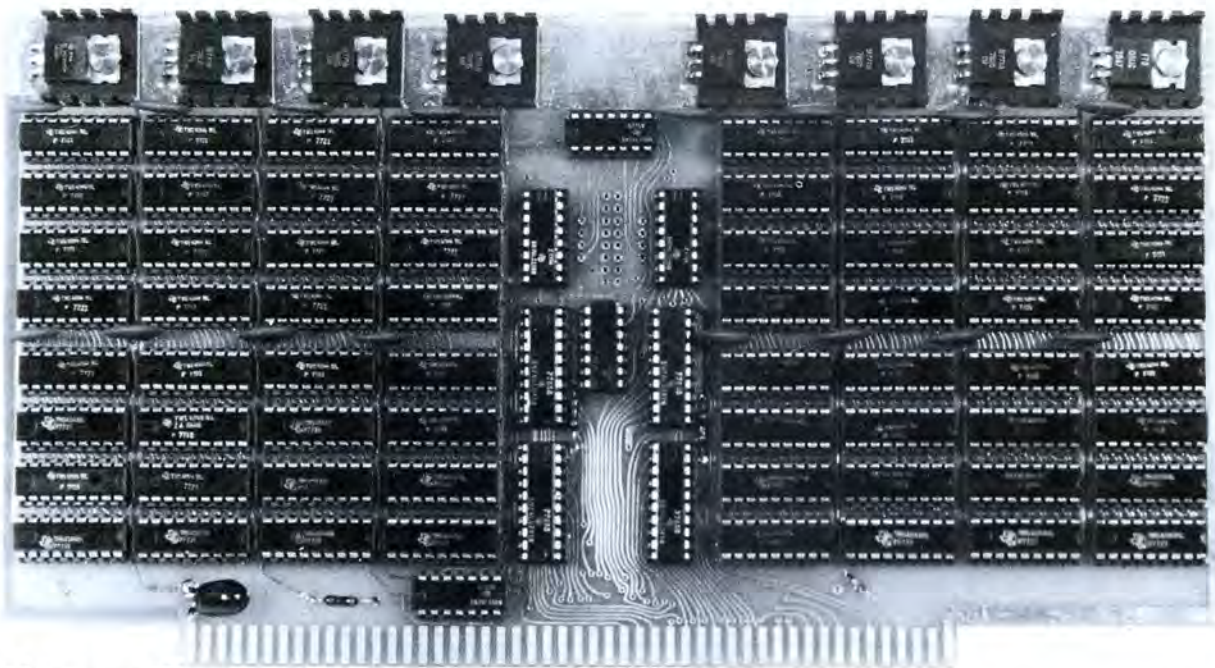
For those of you who are looking at foreign markets, I suggest that

you look at these markets very carefully. The problem is this: those of you who are successful now will be enormously successful in the future. If you are not very careful when you establish foreign distribution network now, you will sorely regret it in the not-too-distant future. Select your distributor with care. Get references, and have the U.S. Government Department of Commerce check them out (for a fee) if they are a foreign-based company. When you write a contract with a foreign distributor, make certain that the contract has been looked over by an attorney who is familiar with the law in the foreign countries that you plan to sell to. European common-market law, for example, is markedly different from U.S.A. law. It is very easy, when you are beginning a small operation, to make a vague contract with someone who you believe to be your friend, bypassing attorneys entirely on the grounds that they are too expensive. That is a mistake. The small saving that may accrue from not using an attorney could result in your being taken to the cleaners by your distributor.

The real message in the foregoing paragraphs is this: there are many of you reading this column today who in a couple of years will be running very substantial operations. If you do not prepare for the day when you are successful, you may be sorry when that day comes. You are operating in an industry of explosive growth; even if your company or personal operation is insignificantly small today, you should begin now to operate on the basis that it will be quite large tomorrow. If you want to talk about foreign distribution (or anything else), call me at (415) 548-2805.

Those of you who can should come to Micro-Business '78 in Pasadena, California. This show will be held on March 17, 18, and 19. Now, I do have some vested interests in asking you to come, because INTERFACE AGE is sponsoring the show and I have been putting together the symposium series that goes with it. (One helluva symposium series). But, despite the vested interests, I do believe it is a good idea to come, because so far as microcomputer systems are concerned, 1978 will go down as the year of the small business system. There are hundreds of small companies putting together business systems based on microcomputers. There are tens of thousands of small businesses anxiously looking at these business systems in the hopes of buying one. There





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Low power and high reliability are key features of the design. The TI 4044's (or equivalents) provide storage capacity at up to 65% less power than low power 21L02 chips. The power required is 1.7A at 8V. for model 1600 and 3.3A at 8V. for model 3200. A special thermal design which places a separate regulator on each 4k x 8 section of memory affords a very efficient system of heat dissipation.

The most outstanding feature of the board is its versatile addressing. Each 4k x 8 section is separately assignable to any 4k slot in the computer's address space. This feature allows the user to make use of the growing amount of software that requires this and avoids the problems associated with only being able to assign the board to a continuous 32k block. In addition, the Megextend™ feature allows up to one megabyte to be addressed providing there is a 4 bit output port in the system. This allows up to 32 model 3200 boards per system, as long as the power requirements are met.

The model 1600 is the same as the 3200 except that it only contains 16k of memory chips. The 1600 may be converted to a 32k board by merely installing the extra 16k of memory chips. The sockets for the additional 16k are installed as a standard feature of the model 1600.

Both models are silk-screened and solder masked on FR4 epoxy board with a gold plated bus connector. They are fully socketed, assembled, tested and burned in.

To order, simply phone Trace Electronics at 215-779-3677 or mail the attached coupon. So as to provide quick delivery all orders will be shipped by the fastest practical means (e.g. Express Mail, Air Mail, UPS Blue Label, ect.). Model 3200 is priced at \$999. and Model 1600 is \$599. Express shipping is pre-paid. Call or write today.

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are tens of thousands of consultants who will be needed by the customers to tailor systems to the customer's needs.

I marvel at the number of calls I have received from new companies claiming to have an "absolutely unique" product: a small business system based on a microcomputer. There is nothing unique about the buffalo herd; but take heart, there is enough business around for a large number of small companies. Concentrate, at least initially, on selling within 50 miles of your home base, and never sell custom software or hardware. And let me once more caution stores and hardware manufacturers to keep out of the end-user customizing business. Stores and manufacturers should sell standard products. When you deliver your product and get paid for it, the deal should be over. Leave all custom programming and hardware modifications to consultants. That way they make a living and so do you. Those of you who sell total systems to the end user, including custom programs in the package price, will go broke. And the reason you will go broke is because your customer does not know what he wants. Your contract will become a contract where you get paid a fixed sum of money for an unknown amount of work. If you are going to deliver anything more than your standard hardware configuration, make absolutely certain that all future payments will be on a time and materials basis. □

#### CALL FOR ARTICLES

Articles authored by individuals during leisure time are remunerated at a rate from \$15.00 to \$50.00 per published page and articles describing company projects carry author and company byline, but no honorarium is offered. Articles accepted will be acknowledged with a binder check within 30 days of receipt.

Manuscripts should be double-spaced, typewritten pages, one inch margins, and not less than 3½ pages in length (one published page). Pages should be numbered to insure correct text. Photographs should be numbered and labeled on the backside with a description. Photos should be taken with uniform lighting and background, in the form of glossy black and white prints. Tables, listings, etc., shall be on separate sheets. Computer listings shall be printed using a new ribbon to assure darkest print copy. Authors shall supply a statement of their background, expertise and level of accomplishment.

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For article submittal or further information, contact respective editor, INTERFACE AGE Magazine, 16704 Marquardt Avenue, Cerritos, CA 90701 or call (213) 926-9544.

## WHITE COLLAR MICROCOMPUTER

Vectored from Page 30

vice facilities. In total, the result could be a comprehensive support package for the commercial user. The type of package offered by some other manufacturers, and needed from many more.

These products also illustrate an increasingly obvious point — there is no criteria clearly differentiating microcomputers from minicomputers. Certainly neither potential capability nor user results are consistently definitive.

For today's prospective computer purchaser, these new products are more than indications of what he can expect in other future products. Although relatively expensive, perhaps too costly for many who are just becoming computer users, these products show what features are available. By considering his possible uses of these features, a prospective purchaser of a smaller system can determine which, if any, capabilities he can afford to do without. □

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The BFD-68 is well known for its fine software. The system comes with the best disk operating system available and we offer a multitude of other compatible software products. These include a BASIC interpreter with disk file handling capability. By the way, our DOS now easily handles true random access files as well as sequential. Also, we have a super fast BASIC compiler for business applications. In addition, a Text Editor, 2 Assemblers, a

Trace Disassembler useful for program debugging and an Object to Source Code Generator are all stock items available for immediate delivery. A word processor will be available very soon.

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#### Available

We've shipped literally tons of our BFD-68 disk system in the past year and have learned to keep our production up with demand. Give us a call and chances are we'll be able to ship you the new ABFD-68 from stock and charge it to your Master Charge or Visa card. Better yet, ask us for the name of the computer store nearest you that carries our complete line of computer products.



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Plan now to attend the big, new NCC '78 Personal Computing Festival. The program will include special paper, panel, and tutorial sessions on such topics as speech synthesis and recognition, computerized music systems, hardware and software design, computer graphics, and small business systems. All papers will be published in a softbound volume, *Festival Digest '78*, which will be available during NCC.

Festival exhibits will provide an extensive display of commercial offerings by organizations serving the personal computing field. More than 100 companies, occupying over 175 booths, will display systems, components, terminals, software, kits, disc and tape cassettes, relevant publications, and related hobby items.

Rounding out the Festival will be a contest featuring microprocessor systems, devices, and applications ranging from home-brew DOS and graphics terminals to educational applications and computer games. Prizes will be awarded for the best exhibits.

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- ☐ Please keep me up-to-date on Festival plans and activities.
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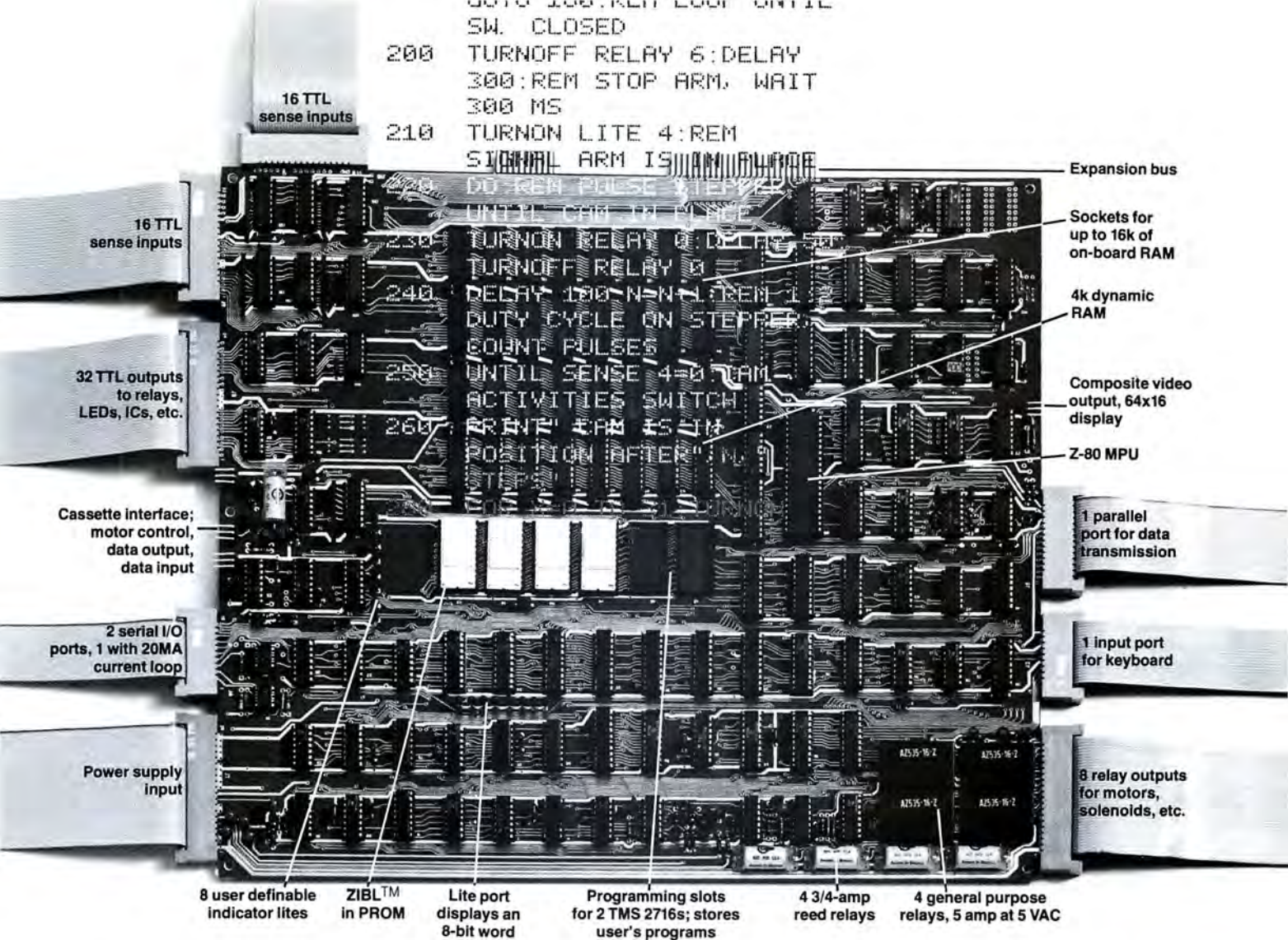
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In ZIBL it is valid to say:

```
100 IF TIME = 053010 AND SENSE
(18) = 0 TURNON RELAY 5
```

Simple, isn't it!

Some but not all of the Basic Controller's mouth watering features

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## DYNABYTE







# THE JURISPRUDENT COMPUTERIST

By Elliott MacLennon, J.D.  
Stephan Murtha

## SUBCHAPTER C CORPORATIONS

This is the third column in a series of columns dealing with the legal, tax, and tactical considerations which go into choosing the form in which to run your business. The first two columns dealt with sole proprietorships, partnerships, and Subchapter S corporations. This column and the fourth and final column will deal with the Subchapter C corporation. This column will discuss the legal and tax mechanics of the corporation, while the fourth column will deal with the tactical ways of utilizing the unique tax and legal situation of the corporation to the maximum advantage.

This corporation has many characteristics which make it unique among business forms. A corporation is the only form in which the business is a separate legal and tax entity, completely independent of the owners. This point is worth pondering for a moment, since it is this unique characteristic of the corporate form which is the root of most of its legal and tax benefits.

The legal aspects of doing business as a corporation are governed by the state from which a corporation receives its charter. The provisions of incorporation in each state vary, but there are very few major differences between them. A corporation typically will be incorporated in the state which it does business, but there are sometimes advantages to incorporating in a state other than the principal state of business.

There are several advantages to the owners of a business which is incorporated which are a result of the legal ramifications of this independent entity principle. They are as follows:

**Limited Liability:** Technically speaking, the corporation transacts all business on its own behalf, including the assumption of debt and liability. Because of this situation, the individual assets of the owners may not be attached if the corporate assets do not satisfy the corporate debts and liabilities. However, as we mentioned in a previous column, for most small businesses this is a moot issue, since those who deal with the corporation will require that the owners personally guarantee all debts and liabilities of the corporation.

**Transferability of ownership interest:** Associates or participants in other forms of business are not barred from transferring their interests, but for several reasons the shareholder of a corporation has a distinct advantage over the others. The shareholders interest is evidenced by a piece of paper called a stock certificate and these certificates dictate the ownership, whereas in a partnership, the ownership is specified

in the partnership agreement. In a corporation the transfer of interest is carried out by simply transferring stock certificates, whereas in a partnership, the partnership agreement must be rewritten. In addition the ownership of a corporation is much more easily divisible among many people, and the mechanics of differentiating between the duties and interests of owner-managers and investors is often more easily accomplished with the corporate form.

**Continuity of existence:** Implicit in the concept of a separate legal entity is a continuity of the corporation wholly unrelated to the lives and vagaries of the human beings who make it up. The death or withdrawal of a partner dissolves the partnership automatically. However, these events have no effect on the life of a corporation. Blackstone in his *Commentaries*, gives a very descriptive metaphor: a corporation is "a person that never dies; in a like manner as the River Thames is still the same river, though the parts which compose it are changing every instant."

While the corporation offers these and other legal advantages, and very significant tax advantages, which will be discussed later, it also has the distinction of being the most costly and regulated form of doing business. In addition to the cost of incorporation there can be considerable costs involved, in the form of franchise taxes, expenses incurred in the filing of annual state and federal forms, keeping of records and minutes of meetings, etc.

For most businesses the question of whether to incorporate is based on tax considerations. In most small businesses the legal advantages are not significant enough to justify the large expense involved in forming and maintaining a corporation. A corporation is usually feasible only when the expected tax savings meet or exceed the annual costs of incorporation. The remainder of this column will deal with the tax treatment of a corporation.

As in legal matters, the corporation is treated as a separate entity for tax purposes. A corporation files its own return, form 1120, and pays a tax on its reported income, unlike the partnership, Sub S Corporation, or sole proprietorship where the income is simply passed on to the individual 1040s of the owners. The current tax rate for federal tax purposes is a flat 20% on the first \$25,000 of income, 22% on income between \$25,000 and \$50,000 and 48% for all income over \$50,000.

Two words form the focal point of the perpetual struggle between the taxpayer and the IRS on the matter of corporate taxation; deductions and dividends. In order



to see why they are so important, let's quickly review the way a corporation reports and distributes income. A corporation reports revenues and offsets that income with allowable deductions to arrive at its taxable income. The appropriate tax is then paid and the balance of the income goes into retained earnings where it stays to be reinvested into the business or it is paid out in dividends to all shareholders, whether they are employees or not.

The income which is left in retained earnings will usually increase the value of the stock. Thus there are only three ways an owner can get money out of the corporation. They are drawing a salary as an employee, by receiving a dividend, or by selling his shares for more than he paid for them. Since the owner usually has to sell all of his stock at one time, salaries and dividends are the two most common methods of distribution of corporate income. A salary is only taxed once, at the individual level, whereas a dividend is taxed twice, once at the corporate level and once at the individual level.

A shareholder can receive economic benefits from the corporation in one more way. He can have the corporation pay for and deduct an item which he normally would have to pay for personally. If this is a qualified expense, he does not have to report this item as income and hence it is never taxed.

To summarize the preceding discussion we can see that there are four ways to get economic benefits out of a corporation. They are listed in decreasing order of desirability.

1. The corporation pays for an expense otherwise borne by the employee and the employee is not required to report it. No taxation.

2. The corporation pays a salary to the employee or pays for an expense otherwise borne by the employee. Both must be reported by the employee. Taxes once.
3. The corporation pays dividends with after-tax dollars to the shareholders who then report the dividends and pay taxes. Taxed twice.
4. The shareholder sells his shares of stock which have appreciated with after-tax dollars reinvested by the corporation. The shareholder pays capital gains tax on the gain. Taxed twice.

It should be obvious at this point that the taxpayer would like to put all transactions in 1 or 2 and the IRS would like to see them all in 3 or 4. Next month's column will pick up from here and discuss ways to place transactions into categories 1 and 2. □

*The business world is made up of more than people and computers, but laws that determine day to day actions.*

*This column is written to provide businessmen with important legal information as it relates to the real world.*

*Anyone seeking further information can contact the authors directly at: DIA Associates, Professional Insurance Services, 3 Altarinda, Suite 304, Orinda, California 94563.*

—Editor

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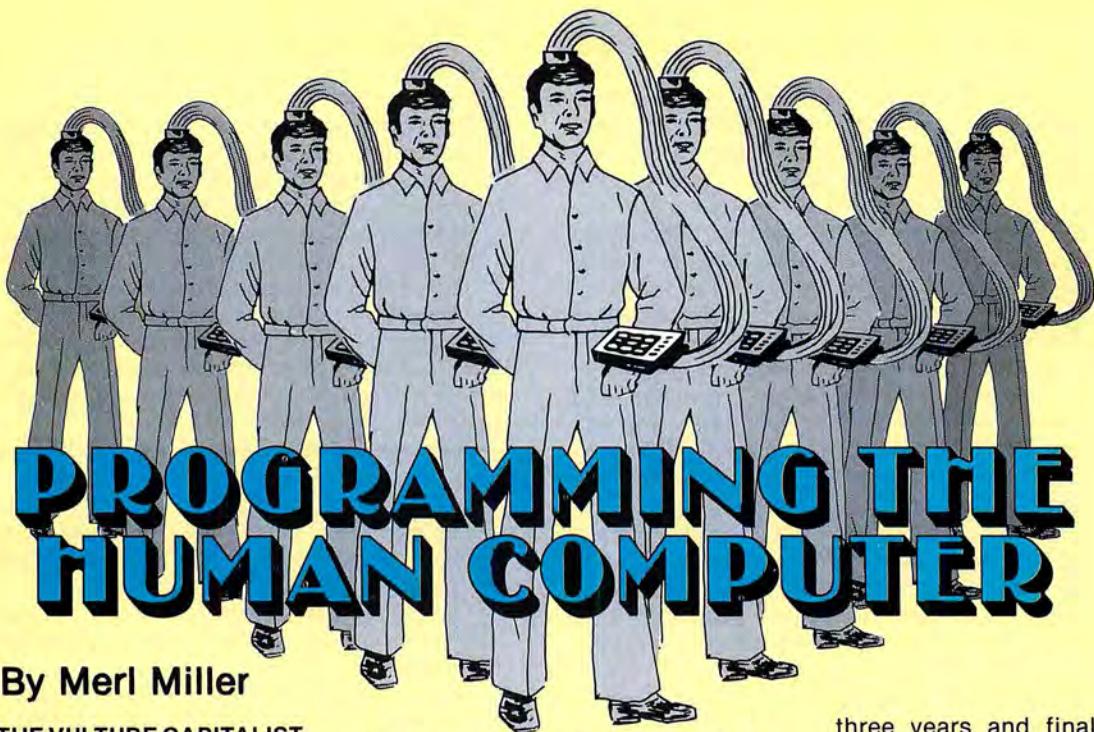
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By Merl Miller

### BEWARE THE VULTURE CAPITALIST

In addition to hard work, what else do you need to start a small business? Beauty, brains, talent, money? All. (Well, maybe not beauty; there are some very successful people who are kind of homely.) The most often overlooked thing, and usually the most crucial, is money.

To successfully start and operate a business of any kind, you need capital. Capital can be defined in many ways, but a working definition for the small businessman might be: Capital is the amount of money you intend to lose before you make any. For instance, let's say that you intend to open a computer store. You decide you need \$20,000 worth of inventory and \$10,000 worth of operating expense for three months. This means you need \$30,000 capital. If, at the end of three months, you are able to meet your operating expenses you won't need additional capital. But, if all you do is meet expenses, you are not providing a return on the investment. The \$30,000 is essentially "lost" until you have sufficient saleable assets to cover it or profits to repay it.

All right. So you know what capital is. What you really want to know is where to get some. The major sources are friends, relatives and private investors. If you think about it, friends and relatives are also private investors. There are also some government programs and the like. I'll give you some contact addresses at the end of this month's column. For the time being, though, let's turn our attention to private investors.

Anyone who invests in a new company is a venture capitalist. A friend of mine jokingly refers to profes-

sional venture capitalists as "vulture" capitalists. It is one of those jokes that is too true to be funny. If you have the brains and talent to start a new company, but you have little or no money, you may have to deal with people like this. These three principles may save you a lot of grief:

1. First, and most importantly: Get everything in writing. Have everything spelled out and signed by all parties. If someone is going to provide a service, have him specify it. For instance, a venture capitalist may say, "We are going to provide you with administrative support." You might think this means he is going to provide accounting, shipping, receiving and secretarial help. What he means is a desk in his warehouse.
2. Do not give up control. Keep this one, very simple fact in your mind — *if you own less than 50% of a company your work for, you are an employee, not an owner.* Here is what can happen if you don't have control. Suppose you come up with a great idea for producing and marketing software. You don't have any money, nor do your friends or relatives. However, you find a private investor who is willing to help you. You figure you will need \$50,000 to get this company off the ground, so he agrees to put up the \$50,000 for 51% of the company. His only condition, he says, is that you also put in \$50,000; but you have ten years to put it in. This sounds like a good deal to you. (It isn't.) You work 50-60 hours a week at one-half your former salary for

three years and finally get the company to the point where it will make a profit. Now what happens? He fires you and gives his son-in-law your job. Or he decides to sell the company to someone else and the new person fires you. Or he decides he would rather have the tax loss so runs up the expense or doesn't pay the bills and puts the company out of business. He can do anything he wants. After all, it's *his* company. Even if none of this happens, you still don't get anything. (How can you afford to buy stock if you have to work at half salary?)

3. Put a value on your brains and talent before you start the company. If the company can't exist without you, you are a very valuable commodity. In the microelectronics and small computer business this is a very real possibility. It takes someone extremely talented to start a small company in this business, so don't give the business away to the first person who offers to support you. You should be able to get at least a 10 to 1 ratio. That is, for every \$1 you invest, other investors have to invest \$10. If you are really good, you might be able to get a 25 to 1 ratio. Invest your share immediately and don't give up control.

The best possible situation in a company is where no one has absolute control. This is due to the old axiom, "Power corrupts; absolute power corrupts absolutely." Don't give up control and don't ask for it. You'll be a lot happier and your business will thrive.

Now, let's look at some sources. Generally, banks are a poor place to



# The 2650 is designed for you

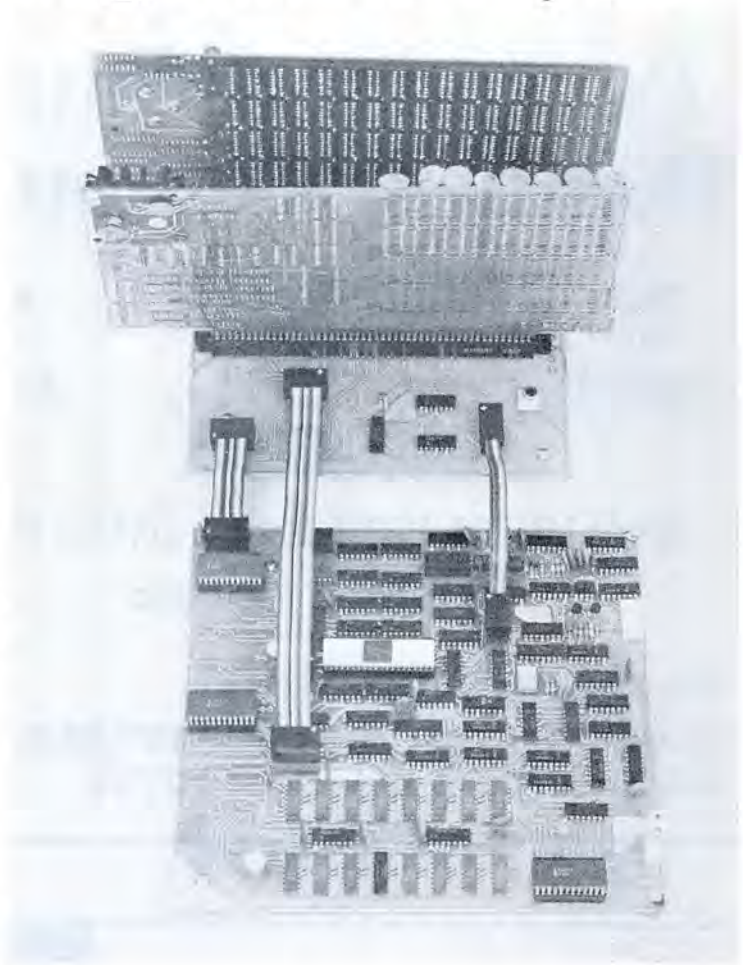
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go to get money for a small business; but there are some notable exceptions. If you have a good inventory and you have been in business at least two years, by all means, approach a bank. A good potential for loans is the SBA (Small Business Administration). The SBA can guarantee a bank loan or loan you the money directly. Contact any bank for the address of the SBA nearest you.

One of the sources of capital that you may not be aware of is the SBIC (Small Business Investment Company). SBIC's are more liberal in their investment and loan policies than most other sources of financing. The SBIC will either loan you money directly or invest in your company. SBIC's are financial institutions created specifically to provide money to small business. For more information and the name of the SBIC nearest you, write: The National Association of Small Business Investment Companies, 512 Warlington Building, Washington, D.C. 20005.

Starting next month, this column will alternate with a new column entitled, "The Mind Revolution." If you have ideas about what you would like to see discussed, I'd love to hear from you. My address is, 30 N.W. 23rd Place, Portland, OR 97210. □



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# SENSE LINE

By Robert Reiling

President, Homebrew Computer Club  
and  
Editor, Homebrew Computer Club Newsletter



THE HOMEBREW COMPUTER CLUB, A Hobbyist Forum in Silicon Valley was formed March 5, 1975. The Homebrew Computer Club is one of the oldest major hobbyist clubs for personal computer enthusiasts in the world.

Its purpose is to promote sharing of information concerning the development and appli-

cation of microcomputer technology. The original club group consisted of 32 computer enthusiasts. That quickly grew, however, and today five to ten times that number are regular attendees at the club meetings. The club is a nonprofit educational corporation chartered in the State of California.

The organization attracts experts in the field of microcomputer technology as well as hobbyists from all over the San Francisco Bay Area.

The following statistical data taken from past issues of the Homebrew Computer Club Newsletter illustrate the club growth and the related number of microcomputers owned and operated by the group. The information was gathered by on-the-spot surveys taken at regular club meetings.

Homebrew Computer Club first meeting —  
March 5, 1975

First meeting attendance — 32 people

Computers up and running — 5

First newsletter published — March 15, 1975

Homebrew Computer Club meeting — October 15, 1975

Attendance — 80 people

Computers up and running — 38

Homebrew Computer Club meeting — June 9, 1976

Attendance — 250 people

Computers up and running — 101

Homebrew Computer Club meeting — January 19, 1977

Attendance — 240 people

Computers up and running — 182

Homebrew Computer Club meeting — January 4, 1978

Attendance — 175 people

Computers up and running — 172.

As may be expected the percentage of microcomputers in use by the people reporting has increased significantly. During the past year a decrease in attendance has occurred which may be due to the increasing availability of microcomputer related information in publications such as INTERFACE AGE. Few women attend the meetings but a small increase has been noted. However, the percentage remains under five percent of the attendance.

The meetings of the Homebrew Computer Club are somewhat unique and are devoted to providing the maximum opportunity for participation and information exchange. Seldom is there a preplanned program and there is never any great amount of time devoted to a "business meeting."

What, then, happens at a Homebrew Computer Club meeting?

First, there is a "mapping period" where each person has an opportunity to ask a question and usually one or more people will respond with an answer. No lengthy discussions are allowed during this period. A later period, called the "random access period" is reserved for extensive information exchange. Also, during the mapping period, anyone having new or interesting products, software or information are given the opportunity to speak. Very often, the latest rumors from Silicon Valley manufacturers are heard. This is not unusual because a number of the club members are employees of firms involved in microprocessors.

During the mapping period, control is ably maintained by the meeting moderator, Lee Felsenstein. With 150-200 or more people on hand, it is important. The following "random access period" is the time to pursue the more detailed discussions. Random access is a sort of free-for-all get-together period to carry on the contacts established during the mapping period. It is also a time when special interest groups meet to exchange the latest ideas on a specific computer system or project.

The development of special interest groups has probably been the biggest change during the past year. At the beginning of the year the 6800 group was holding regular meetings. At the end of 1977 the groups include not only the 6800 group but the F8 Users, North Star Users Group, SOL Users Society, and PET Users. In addition, the IEEE now has a standards group to sort out the various hardware and software standards.

Another interesting local group activity is the personal computer network committee. The PCNET (Personal Computer NETwork) committee has been functioning in this area since April, 1977. The committee's goal is the creation of regional (followed by national) personal computer networks for the computer-to-computer transfer of messages and files. A set of network protocols (sets of conventions defining all levels of intercomputer communication) is nearing completion. These protocols should be operable in 8K bytes of machine code and are designed to be implemented in string BASIC.

The committee believes the network will be attractive to personal computer users. Participation will be voluntary; you can decide to participate (or not) on any given day of network operation. Network functioning will be relatively insensitive to the absence of a large number of member computers. Current thinking indicates that a personal computer with string BASIC, 12 to 16K of RAM, and an originate/answer MODEM capable of 300 BPS will be required for participation in the network.

A remarkable number of microcomputer organizations can trace their start to inspiration and encouragement from Homebrew Computer Club meetings. Often alliances were formed when people with similar interests and ideas met at club meetings. A visitor to a club meeting should not be surprised to see key technical and management personnel from organizations such as Apple, Commodore, Computer Faire, Cromemco, Dr. Dobbs Journal, IBEX, Itty Bitty Computers, M&R Enterprises, Mountain Hardware, Mullen Computer Boards, North Star, Peoples Computer Company, Processor Technology Corporation, and the many computer stores in the area.

The computer hobbyist and technologist is very fortunate to live in the San Francisco area indeed. Computer stores are everywhere (at least 30 in the area), major microcomputer manufacturers are employers of qualified people allowing the hobbyist to take his hobby to work, and part suppliers are readily accessible for the experimenter and builder.



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Of course help with hardware and software problems is always at hand from Homebrew Computer Club members. A club library has a variety of software and technical data for exchange by members. Gordon French is the custodian. It was Gordon's home where the first club meeting was held.

The club has a monthly newsletter. It contains club information, new product data, programming ideas, tutorial material, and a bulletin board for member announcements. It is data from the club newsletter that was used to prepare the statistical data at the beginning of this article. Of the people reporting computers up and running on January 4, 1978, the newsletter carried the actual mix by CPU type. The table is reproduced here for comparison with your club list.

CPU TYPE	NUMBER	SYSTEMS OPERATING
8080		68
8008		4
6800		12
6502		28
F8		5
LSI 11		5
1802		5
9900		2
6100		2
SC/MP		2
PACE		1
8085		1
OTHERS		6
TOTAL		172

The Homebrew Computer Club Newsletter is mailed throughout the world reaching hobbyists and others interested in personal computers. Newsletter readers are currently located in Israel, Luxembourg, Netherlands, New Zealand, Japan, Australia, Belgium, Brazil, as well as throughout the United States, Mexico and Canada. Distribution numbers 1000 to 1500 copies per issue with 10 to 12 issues per year. For easy reading the newsletter is professionally typeset and laid out. New product information is solicited from the industry and interesting product news published. Readers are encouraged to submit articles and to share their experiences in the microcomputer world. The Homebrew Computer Club Newsletter typesetting, printing, and mailing costs are paid from donations to the Homebrew Computer Club by readers.

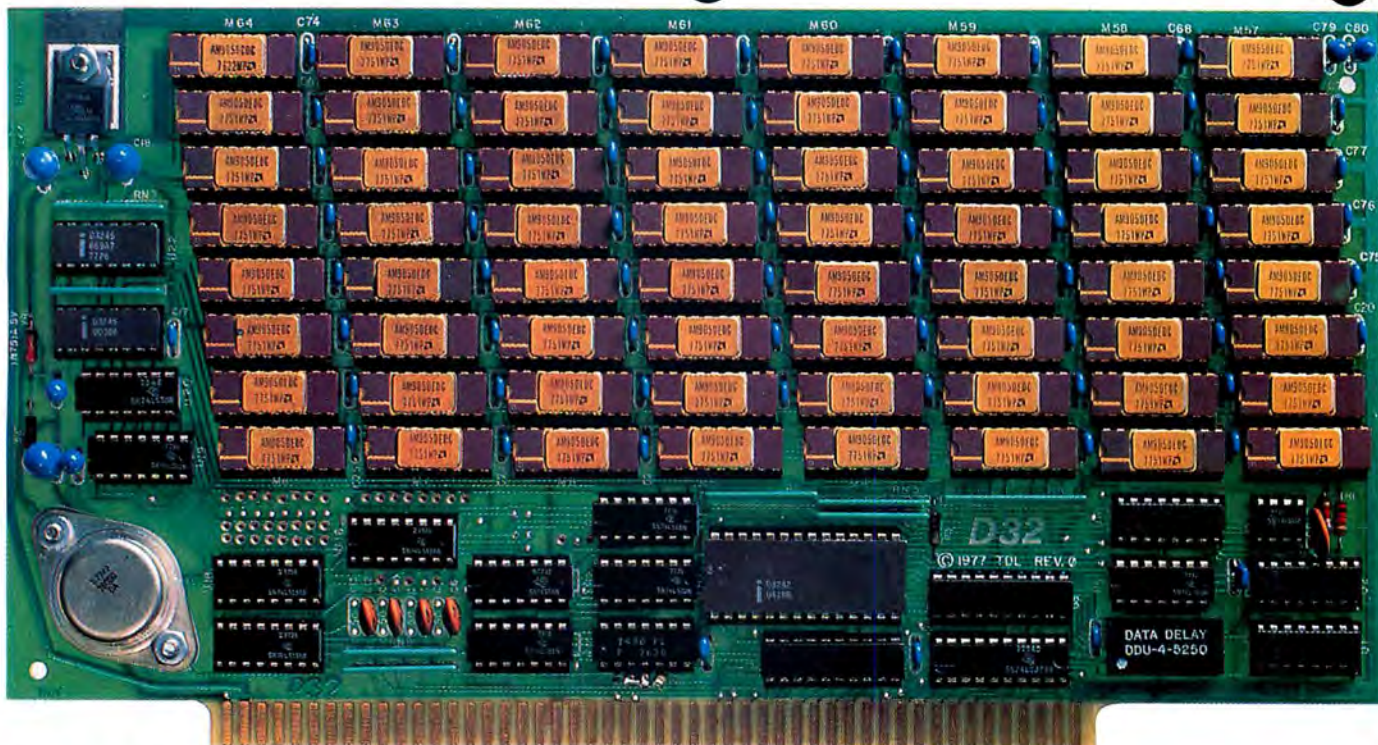
It has been an exciting growth period and one in which I am delighted to have participated. During the next year the growth will continue but we will see hardware and software that is easier to use. The systems will be packaged so that you can take it home, plug it in, select a program tape or cartridge or some sealed box that has the magic program, and operate your new system for fun and profit. We will find more good software with really worthwhile applications that will make life a little easier. Some will say the "plug in and go" users are just appliance operators. That may be, but I believe we are just at the start of a new growth in the microcomputer era.

The Homebrew Computer Club will change, too. Better educational materials will be needed for the group of new users. Club meetings will also be an excellent meeting place to discuss those "bugs" that somehow turn up in new products. I can hardly wait. In the meantime, I will see you at the next Computer Faire where I will be searching for the fascinating new products that will reach the market this year.

A sample Homebrew Computer Club Newsletter, listing meeting dates and location may be obtained by sending a stamped, self-addressed envelope to the Homebrew Computer Club Newsletter, P.O. Box 626, Mountain View, CA 94042. □



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### Maximum Reliability

The D-32 is as reliable as static memory boards, since close attention has been paid to the proper engineering discipline to maximize reliability. These details include: the use of molded ceramic bypass capacitors for superior noise immunity, keeping trace lines to the edge connector to a minimum to suppress noise spikes on the bus, precisely-controlled timing and a multi-layer PC board with internal power and ground planes for superior noise immunity.

### Expandability

The D-32 has a fully-transparent, dynamic refresh. Each 4096 byte block is addressable at any 4K page boundary. Extended address selection allows expandability to one megabyte co-resident in the system.

### Main Features

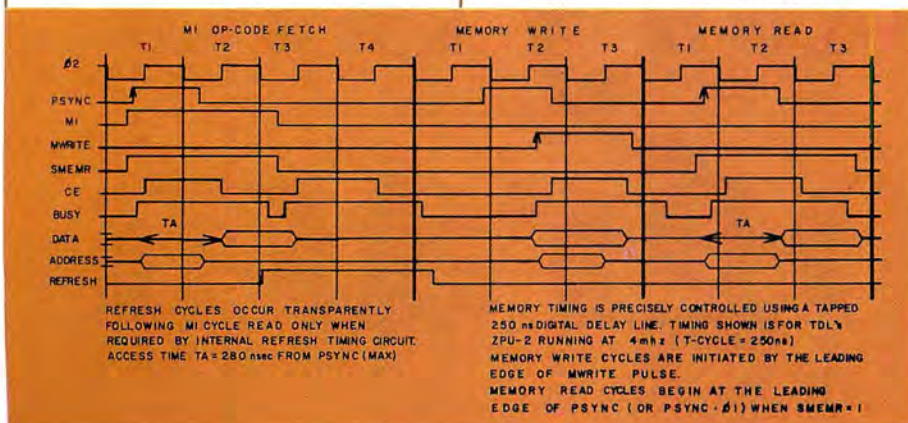
- immediately available, fully assembled and tested
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# A Financial Analysis Program

By Peter M. Burke



The following is what I believe to be a most useful program written in the BASIC language. It will solve most any financial problem that one might run into in the area of future and present values. It does compute most if not all of the functions that a Hewlett-Packard 22, 27 or 80 will compute in the area of present and future values. I will first explain the basic concepts and their formulae, and then give examples of output from the program. The computer program has been broken up into the following three areas: 1) annuities, 2) lump sums, and 3) bonds. I will deal with each of these areas one at a time. In these types of problems one is solving for an unknown, given the other factors, in the program a 0 is inputted for that unknown and it will be solved. The following notation will be used:

FV = future value amount or BALLOON payment  
 PV = present value amount  
 PMT = payment to be made  
 n = the total number of periods  
 i = the interest rate per year as a %. (i.e. 8% = 8)  
 C = the number of compounding periods per year  
 TYPE = type of annuity — 0 = normal, 1 = annuity due

**LUMP SUM CALCULATIONS:** This section of the program will compute any one of the four following variables, n, i, PV or FV given the other three variables.

**FUTURE VALUE:** The future value is defined as the amount of money that one would accumulate after investing PV dollars at i/C rate of interest per period, for n number of periods.

**Example:** If I deposit \$100.00 today into a bank account for five years, at 6% annual interest, which will be compounded quarterly, how much money shall I have at the end of the five years?

**Answer:** \$134.69

The formula used to calculate future value =  $FV = PV(1 + i/C)^n$ .

\*\*\*\*\*  
 WHICH TO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 2

ENTER N, I, PV, FV, COMPOUNDING  
 ? 20, 6, 100, 0, 4

THE FUTURE VALUE = 134.690

DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

**PRESENT VALUE:** The present value is just the opposite of the future value. It is the amount of dollars that you would have to invest today at i/C rate of interest per period, for n number of periods to reach a given or desired future value.

**Example:** I want to have \$660.00 in my savings account in six years, it pays 5% annual interest compounded semi-annually, how much must I invest today to achieve this?

**Answer:** \$490.75

The formula to compute present value is  $PV = FV(1 + i/C)^{-n}$ .

The present and future values have an inverse relationship as shown below:

$PV = 1/FV$   
 $FV = 1/PV$   
 $FV: (1 + .05)^5 = 1.276282$   
 $PV: (1 + .05)^{-5} = .783526$   
 $FV: 1/.783526 = 1.276282$   
 $PV: 1/1.276282 = .783526$   
 \*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 2

ENTER N, I, PV, FV, COMPOUNDING  
 ? 12, 5, 660  
 ? 12, 5, 0, 660, 2

THE PRESENT VALUE = 490.75

DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

**NUMBER OF PERIODS:** The number of periods is the total number of compounding periods that are needed to accumulate a FV number of dollars at i/C rate of interest per period, given PV dollars of investment. (Note: the program rounds off the number of periods).

**Example:** If I invest \$150.00 at 7% annual interest which is to be compounded monthly, and I shall accumulate \$250.00, how many periods must I leave my investment in to achieve this?

**Answer:** 87.83 periods (months)

This figure rounded becomes 88 periods (months).

The formula used to calculate this is:

$$n = \frac{1n(FV/PV)}{1n(1 + i/C)}$$

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 2

ENTER N, I, PV, FV, COMPOUNDING  
 ? 0, 7, 150, 250, 12

THE NUMBER OF PERIODS = 88

**INTEREST RATE:** The annual interest rate is the rate of interest that is paid on the money invested. But as in many cases the money will be compounded more than once per year, and if this is the case, the periodic rate of interest will be i/C.

**Example:** If I invest \$100.00 today at i/C% per period compounded monthly for six years, and accumulate \$275.00 during that time, what rate of interest will have been paid on my money?

**Answer:** 16.98%

The formula to compute the interest rate is as follows:

$$i = \left( \sqrt[n]{FV/PV} - 1 \right) \cdot C \cdot 100$$

This formula can be converted from a root function to a power function by using the following formula:

$$i = ((FV/PV)^{(1/n)} - 1) \cdot C \cdot 100$$

\*\*\*\*\*  
 WHICH TO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 2

ENTER N, I, PV, FV, COMPOUNDING  
 ? 72, 0, 100, 275, 12

THE INTEREST RATE = 16.980

DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

## BONDS

The second area of the computer program that I shall discuss is that of bonds. The calculation of bond values is a most useful one, and the program in this area will compute the price, or the yield to maturity of a bond. It is assumed the bond is of a \$1000.00 face value, and coupon payments are every six months.

**PRICE:** The price of a bond is the present value of all of its remaining interest payments, and the present value of its terminal value, which is \$1000.00. The discount



rate used to calculate this total present value should be the going rate for similar rated bonds.

**Example:** What is the price of a bond that has a 5.5% coupon rate, which will mature in 15 years, and the going rate on similar bonds is 6.75%?

**Answer:** \$883.23

The formula used to calculate the price of the bond is:

$$\text{PRICE} = \left[ \left( \frac{1 - (1 + i/C)^{-n}}{i/C} \right) (1000 * Cr/2) \right] + \left[ \frac{1000}{(1 + i/C)^n} \right]$$

Where:  $i$  = the discount rate as a decimal percent  
 $n$  = the number of years to maturity times two  
 $Cr$  = the coupon rate on the bond

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 3

ENTER # OF YEARS, DISCOUNT RATE, COUPON RATE, PRICE  
 ? 15, 6.75, 5.5, 0

THE PRICE OF THE BOND = 883.230

**YIELD TO MATURITY:** The yield to maturity is the yield the bond holder will realize over the life of the bond, if he buys the bond at a given price, and holds it until maturity.

**Example:** If I pay \$905.00 for a \$1000 par value bond which has a semi-annual coupon payment of 8% per year, and it will mature in 18 years, what will my yield to maturity be for the bond?

**Answer:** 9.0799999%

The formula used to compute this is:

$$\text{PRICE} = \left[ \left( \frac{1 - (1 + i/C)^{-n}}{i/C} \right) (1000 * Cr/2) \right] + \left[ \frac{1000}{(1 + i/C)^n} \right]$$

There is no formula which will calculate the yield to maturity, so the  $i$  in the formula must be guessed, and guessed again until an interest rate that is used will get the PRICE within a range of the actual price, this range I used as a  $\pm$  one dollar.

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 3

ENTER # OF YEARS, DISCOUNT RATE, COUPON RATE, PRICE  
 ? 18, 0, 8, 905

THE YIELD TO MATURITY = 0.0799999%

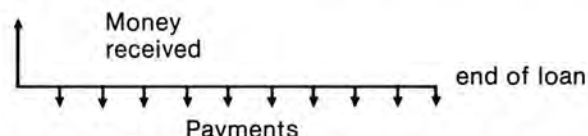
DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

## ANNUITIES

This is the third and last major area of my program, annuities constitute what I believe to be the largest single area of common everyday calculations. An annuity is a constant flow of payments of equal value that are used either to discharge a debt, or to build a reserve for a future date. Thus, we now have the two most common types of annuities, the present value annuity, and the future value annuity. In both of these types of annuities we have variations. In the present value annuity we have two variations other than a normal present value annuity. They are the balloon payment, and the present value annuity due. In the future value type annuity we have one other type and that is the future value annuity due. An annuity due is an annuity where the regular payment occurs at the beginning of a period, rather than at the end of a period. A balloon payment is a payment that usually occurs with the last payment on a present value type of annuity. It will occur with an early payoff of a loan, and it may be present in an annuity due type of present value

type annuity. I will now go through each type of annuity starting with the present value annuity.

**PRESENT VALUE ANNUITY:** A present value annuity is most commonly used in the banking industry. A most common example is that of the loan on a house which is almost always of this type. The cash flow on this type of annuity looks as follows:



**Example:** If I borrow \$40,000.00 from a bank for twenty-five years at 9.75% interest with monthly payments, what will those payments be each month?

**Answer:** \$356.46

The formula to compute this is:

$$\text{PMT} = \text{PV} * \left[ \frac{i/C}{1 - (1 + i/C)^{-n}} \right]$$

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
 ? 300, 9.75, 0, 40000, 0, 12, 0

THE PAYMENT AMOUNT = 356.460

DO YOU WANT A LOAN SCHEDULE PRINTED OUT  
 ? NO

DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

The other formulas used in this present value annuity calculation are shown here with a computer run calculating each of them, using the above example.

$$\text{PV} = \text{PMT} * \left[ \frac{1 - (1 + i/C)^{-n}}{i/C} \right]$$

(Note: a rounding error caused the below output to be slightly off.)

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
 ? 300, 9.75, 356.46, 0, 0, 12, 0

THE PRESENT VALUE OF THIS ANNUITY = 40000.550

DO YOU WISH TO MAKE ANOTHER RUN  
 ? YES

$$n = \frac{1n(1 - (i/C/PV)/(PMT * (1 + i/C)))}{1n(1 + i/C)}$$

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
 ? 0, 9.75, 356.46, 40000, 0, 12, 0

THE TOTAL NUMBER OF PERIODS = 300

There is no formula that will solve for interest, but rather one must try different rates until the present value at this rate actually equals the amount of the loan (present value).

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
 OR A (3) BOND CALCULATION  
 ? 1



ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 300, 0, 356.46, 40000, 0, 12, 0

THE ANNUAL INTEREST = 9.75%

Below is a printout of a loan schedule that is generated by the program. You can print out the entire loan schedule, or just a portion of it.

\*\*\*\*\*

DO YOU WANT A LOAN SCHEDULE PRINTED OUT  
? YES

ENTER FIRST AND LAST PAYMENT NUMBER  
? 1, 12

THE PAYMENT AMOUNT = 356.460

THE PRINCIPAL AMOUNT = 40000

THE ANNUAL INTEREST RATE = 9.75

THE TOTAL NUMBER OF PAYMENTS = 300

THE BALLOON PAYMENT = 0

PMT #	PRINCIPAL	INTEREST	REM. BAL.	TOT. INT.
1	31.460	325	39968.540	325
2	31.720	324.740	39936.830	649.740
3	31.970	324.490	39904.850	974.230
4	32.230	324.230	39872.620	1298.460
5	32.490	323.970	39840.120	1622.420
6	32.760	323.70	39807.370	1946.120
7	33.030	323.430	39774.340	2269.560
8	33.290	323.170	39741.050	2592.730
9	33.560	322.90	39707.480	2915.620
10	33.840	322.620	39673.650	3238.240
11	34.110	322.350	39639.540	3560.590
12	34.390	322.070	39605.150	3882.660

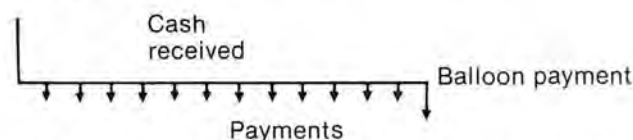
DO YOU WISH TO MAKE ANOTHER RUN  
? YES

**BALLOON:** Another common type of the present value annuity is that of the annuity with a balloon payment. This usually occurs when you desire lower payments, but agree to pay off the loan early. An example would be to schedule a loan for say thirty years, but agree to pay off the loan after twenty-five years. To compute the amount of the balloon payment is very easy. The balloon payment is defined as the remaining balance at the time the balloon is paid off. The formula to be used is:

$$\text{BALLOON} = \text{PMT} * \left[ \frac{1 - (1 + i/C)^{(k-n)}}{i/C} \right]$$

Where  $n$  = total number of payments  
 $k$  = total number of payments made at the time of the balloon payment

The cash flows for this type of annuity would look as follows:



\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 300, 9.75, 340, 40000, 0, 12, 0

THE BALLOON PAYMENT = 20925.180

**PRESENT VALUE ANNUITY DUE:** The next type of annuity that I shall discuss is that of the present value annuity due. This as you recall is the payments at the beginning of a period. I will limit my discussion here because it is so similar to that of the previous type. I will lay out what the cash flows should look like, the formula, and the computer runs relating to the example below.

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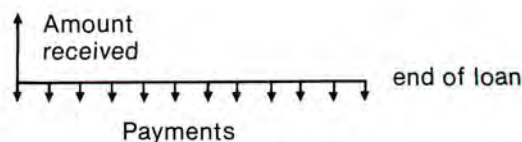
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CIRCLE INQUIRY NO. 33

52 INTERFACE AGE



**Example:** If I borrow \$35,000 at 9.5% interest with monthly payments for thirty years, what will my payments be under an annuity due type of loan?

$$PMT = (PV/(1 + i/C))^* \left[ \frac{i/C}{1 - (1 + i/C)^{-n}} \right]$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 360, 9.25, 35000  
? 360, 9.25, 0, 35000, 0, 12, 1

THE PAYMENT AMOUNT = 285.730

DO YOU WISH TO MAKE ANOTHER RUN  
? YES

$$n = \frac{1n(i/C * (FV/(PMT * (1 + i/C))) + )}{1n(1 + i/C)}$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 0, 9.25, 285.73, 35000, 0, 12, 1

THE TOTAL NUMBER OF PERIODS = 360

The same holds true here again for calculating the interest rate, it is merely the process of trial and error until the present value equals the loan amount.

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 360, 0, 285.73, 35000, 0, 12, 1

THE ANNUAL INTEREST = 9.25%

DO YOU WISH TO MAKE ANOTHER RUN  
? YES

$$PV = \left[ \frac{1 - (1 + i/C)^{-n}}{i/C} \right] * PMT * (1 + i/C)$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? B  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 360, 9.25, 285.73, 0, 0, 12, 1

THE PRESENT VALUE OF THIS ANNUITY = 34999.520

$$BALLOON = \left[ \frac{1 - (1 + i/C)^{(k-n)}}{i/C} \right] * PMT * (1 + i/C)$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 360, 9.25, 280, 35000, 0, 12, 1

THE BALLOON PAYMENT = 11145.630

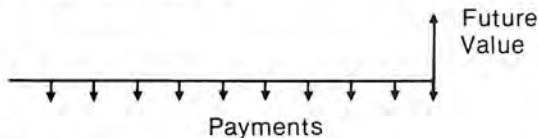
DO YOU WISH TO MAKE ANOTHER RUN  
? YES

**FUTURE VALUE ANNUITY:** The final area that I shall go into is that of a future value annuity, of which there are two types, the normal future value annuity, and the annuity due. A future value annuity is the regular payments of a constant amount into an interest bearing account, for

MARCH 1978



the purpose of accumulating a future sum at the end of the payments. The most common use of this is the whole life insurance policy, where with each payment you are building up its cash value. The cash flows on this type of an annuity look like:



The formula used to find the payment is:

$$PMT = FV * \left[ \frac{i/C}{(1 + i/C)^n - 1} \right]$$

**Example:** If I wish to accumulate a future value of \$200,000 in a bank account which pays 6.5% interest, and will make monthly payments for forty years, what will my monthly payments be?

**Answer:** \$87.58

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 480, 6.5, 0, 0, 20000, 12, 0

THE PAYMENT AMOUNT = 87.580

$$n = \frac{1n(i/C * (FV/PMT) + 1)}{1n(1 + i/C)}$$

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 0, 6.5, 87.58, 0, 20000, 12, 0

THE TOTAL NUMBER OF PERIODS = 480

$$FV = \left[ \frac{(1 + i/C)^n - 1}{i/C} \right] * PMT$$

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 480, 6.5, 87.58, 0, 1, 12, 0

THE FUTURE VALUE OF THIS ANNUITY = 199997.64

DO YOU WISH TO MAKE ANOTHER RUN  
? YES

Again here as with the present value type annuity there is no formula to compute the interest rate, but we must go through trial and error and find the interest rate which makes or calculated future value equal to or desired future value.

\*\*\*\*\*

WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 480, 0, 87.58, 0, 20000, 12, 0

THE ANNUAL INTEREST = 6.5%

DO YOU WISH TO MAKE ANOTHER RUN  
? YES

**FUTURE VALUE:** This is our last variation of the future value type annuity. It is called the annuity due type future value annuity, and as I said before, it is simply the payments occurring at the beginning of a period. Below are the formulas and a picture of how the cash flows should look.

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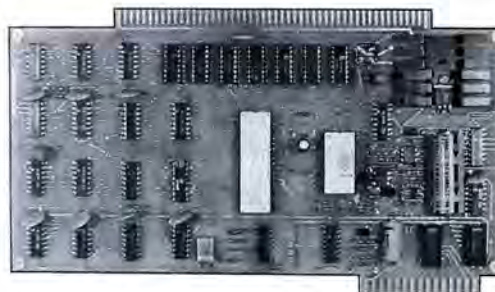
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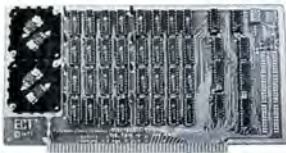
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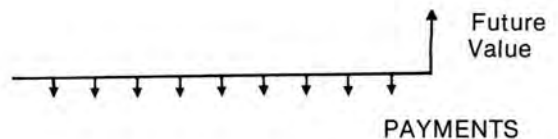
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CIRCLE INQUIRY NO. 46



$$PMT = \left[ \frac{i/C}{(1 + i/C)^n - 1} \right] * (FV / (1 + i/C))$$

**Example:** If I wish to have \$150,000 in the future, and I agree to deposit at the beginning of each month a payment which will earn 7.75% interest for twenty-four years, what will my monthly payments be?

**Answer:** \$178.73

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 288, 7.75, 0, 0, 150000, 12, 1

THE PAYMENT AMOUNT = 178.730

DO YOU WISH TO MAKE ANOTHER RUN  
? YES

$$n = \frac{1n(i/C * (FV / (1 + i/C)) + 1)}{1n(1 + i/C)}$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 0, 7.75, 178.73, 0, 150000, 12, 1

THE TOTAL NUMBER OF PERIODS = 288

$$FV = \left[ \frac{(1 + i/C)^n - 1}{i/C} \right] * PMT * (1 + i/C)$$

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 288, 7.75, 178.73, 0, 1, 12, 1

THE FUTURE VALUE OF THIS ANNUITY = 150000.17

INTEREST: As before the interest rate cannot be calculated other than to use a method of trial and error. We must find the interest rate which will make the future value equal to the desired value.

\*\*\*\*\*  
WHICH DO YOU WANT; (1) AN ANNUITY; (2) A LUMP SUM  
OR A (3) BOND CALCULATION  
? 1

ENTER N, I, PMT, PV, FV(BALLOON), COMPOUNDING, TYPE  
? 288, 0, 178.73, 0, 150000, 12, 1

THE ANNUAL INTEREST = 7.75%

In summary I feel that this is a useful program for those of us that work in financially related fields, or for homeowners. This program was run on the Univac 1108 at the University of Utah, which has a very extended BASIC. I have tried to keep the memory size requirements down and use BASIC commands that would allow any microcomputer with 8K BASIC to run it. □



# PROGRAM LISTING

```

100 REM THIS PROGRAM WAS WRITTEN BY PETER M. BURKE
105 REM 732 SOUTH 4TH EAST / APT. 18 / SALT LAKE CITY, UTAH 84111
110 REM COPYRIGHT PETER M. BURKE -- APRIL 30, 1977
120 PRINT 'THIS PROGRAM WILL COMPUTE THE FOLLOWING:'
130 PRINT '    (1) AN ANNUITY -- EITHER A FUTURE VALUE OR'
140 PRINT '        A PRESENT VALUE AND SOLVE FOR THE PAYMENT'
150 PRINT '        THE INTEREST RATE, THE NUMBER OF PERIODS, THE'
160 PRINT '        PRESENT OR FUTURE VALUE, THE BALLOON PAYMENT'
170 PRINT '        ON A LOAN, PRINT A LOAN SCHEDULE IF DESIRED AND'
180 PRINT '        IT WILL ALSO SOLVE PROBLEMS WHERE THE PAYMENTS'
190 PRINT '        ARE RECEIVED IN ADVANCE'
200 PRINT '    (2) A LUMP SUM -- WILL SOLVE FOR THE FUTURE VALUE'
210 PRINT '        THE PRESENT VALUE, THE INTEREST RATE OR THE'
220 PRINT '        NUMBER OF PERIODS'
230 PRINT '    (3) BONDS -- WILL SOLVE FOR THE PRICE OF A BOND,'
240 PRINT '        OR SOLVE FOR THE YIELD TO MATURITY OF A BOND'
250 PRINT 'THE FOLLOWING NOTATION IS USED:'
260 PRINT 'N= THE ACTUAL NUMBER OF PERIODS'
270 PRINT 'PMT= THE $ PAYMENT PER PERIOD'
280 PRINT 'I= THE ANNUAL INTEREST RATE AS A PERCENT (I.E. 8% = 8)'
290 PRINT 'PV= THE PRESENT VALUE'
300 PRINT 'FV(BALLOON)= THE FUTURE VALUE OR BALLOON PAYMENT'
310 PRINT 'IF YOU ARE SOLVING FOR A FUTURE VALUE ENTER A (1) IN FOR FV'
320 PRINT 'COMPOUNDING= THE NUMBER OF TIMES COMPOUNDED PER YEAR'
330 PRINT 'TYPE= TYPE OF ANNUITY -- ENTER A (0) FOR A NORMAL ANNUITY, AND'
340 PRINT 'A (1) FOR AN ANNUITY DUE (PAYMENTS ARE AT THE BEGINNING OF'
350 PRINT '        A PERIOD)'
360 PRINT
370 PRINT
380 PRINT
390 PRINT
400 PRINT
410 PRINT '*****'
420 FOR Z=1 TO 3 PRINT
430 PRINT 'WHICH DO YOU WANT: (1) AN ANNUITY (2) A LUMP SUM'
440 PRINT 'OR (3) A BOND CALCULATION'
450 IF Z=3 THEN GOTO 460
460 INPUT R
470 FOR J=1 TO 3 PRINT
480 IF R=1 THEN 510
490 IF R=2 THEN 530
500 IF R=3 THEN 540
510 PRINT
520 PRINT
530 PRINT 'ENTER N, PMT, FV, FV(BALLOON), COMPOUNDING, TYPE'
540 INPUT A,B,C,D,E,C5,R2
550 C3=1
560 C4=1
570 C1=C
580 C2=D
590 C6=E
600 DEF FNA(X)=INT(X*100+.5)/100
610 DEF FNB(X,Y,Z)=INT((1+Z/C5/100)**(-Y*C5)*X*100+.5)/100
620 DEF FNC(X,Y,Z)=INT((1+Z/C5/100)**(Y*C5)*X*100+.5)/100
630 DEF FND(X,Y,Z)=INT((X/Y)**(1/(Z/C5)-1)*10000*C5+.5)/100
640 DEF FNE(X,Y,Z)=INT((LOG(X/Y))/(LOG(1+Z/100/C5))+.5)
650 IF E=0 AND R2=1 THEN E=E/(1+R/100/C5)
660 IF R2=1 AND D>0 AND B>0 THEN D=D/(1+R/100/C5)
670 PRINT
680 PRINT
690 REM
700 REM
710 PRINT
720 PRINT
730 REM CONVERTING INTEREST AND PERIODS TO THE ACTUAL PERIODS
740 REM AND THE ACTUAL INTEREST PER PERIOD
750 REM
760 IF E=0 THEN P=R/C5
770 REM TEST TO SEE IF INTEREST IS THE DESIRED OUTPUT
780 IF B=0 THEN 1440
790 IF C6=1 THEN 1320
800 GO TO 990
810 A1=0
820 REM SETTING FLAG (A) IF THE P.V.=0
830 IF D=0 THEN A1=1
840 REM CONVERTING THE INTEREST RATE TO A DECIMAL
850 X=B*.01
860 X7=X*9+1
870 IF A=0 THEN X8=1
880 IF A=0 THEN 910
890 REM X8= 1 + THE DECIMAL INTEREST TO THE -NTH POWER
900 X8=X7**(A*-1)
910 X1=X8*.1
920 X4=1-X8
930 X=C/X9
940 IF A1=1 THEN X3=(X*-1)
950 IF A1=1 THEN 970
960 X3=X
970 X=(C/X9)*(1-X8)
980 RETURN
990 REM SECTION TO SOLVE FOR PERIODS
1000 IF A=0 THEN 1020
1010 GO TO 1090
1020 GOSUB 810
1030 X=(E-X3)/(1-X3)
1040 IF X<0 THEN X=X*(-1)
1050 IF X7<0 THEN X7=X7*(-1)
1060 A=LOG(X)/LOG(X7)
1070 PRINT 'THE TOTAL NUMBER OF PERIODS = 'INT(A+.5)
1080 GO TO 1820
1090 REM SECTION TO SOLVE FOR PAYMENT
1100 IF C=0 THEN 1120
1110 GO TO 1180
1120 C=1
1130 GOSUB 810
1140 C=(1/X)*(D-X1)
1150 C=ABS(C)
1160 PRINT 'THE PAYMENT AMOUNT = 'FNA(C)
1170 GO TO 1820
1180 REM SECTION TO SOLVE FOR PRESENT VALUE
1190 IF F=0 THEN 1210
1200 GO TO 1300
1210 GOSUB 810
1220 D=X*X1
1230 IF R2=1 THEN D=D*(1+R/100)
1240 IF C9=1 THEN PRINT 'THE PRICE OF THE BOND = 'FNA(D)
1250 IF C9=1 THEN 1270
1260 PRINT 'THE PRESENT VALUE OF THIS ANNUITY = 'FNA(D)
1270 GO TO 1820
1280 PRINT
1290 PRINT
1300 REM SECTION TO SOLVE FOR BALLOON PAYMENT
1310 REM TEST TO SEE IF ALL NECESSARY COMPONENTS ARE THERE
1320 REM THAT ARE NECESSARY TO SOLVE FOR BALLOON PAYMENT
1330 IF C1=0 OR C4=0 OR C3=0 THEN 1850
1340 GOSUB 810
1350 F=(D-X)/X8
1360 IF R2=1 THEN E=E*(1+R/100)
1370 E=ABS(E)
1380 IF C6=1 THEN PRINT 'THE FUTURE VALUE OF THIS ANNUITY = 'FNA(E)
1390 IF C6=1 THEN 1410
1400 PRINT 'THE BALLOON PAYMENT = 'FNA(E)
1410 GO TO 1820
1420 REM SECTION TO SOLVE FOR THE INTEREST RATE
1430 REM SETS INITIAL INTEREST TO 15%
1440 R=15/C5
1450 IF R2=1 AND D>0 THEN D=D-U
1460 IF R2=1 AND D>0 THEN A=A-1
1470 IF R2=1 AND E>0 THEN E=E+C
1480 IF R2=1 AND E>0 THEN A=A+1
1490 GOTO 1500
1500 REM
1510 REM FINDS PRESENT VALUE OF ALL PAYMENTS
1520 F=(1-(1+R/100)**-A)/(R/100)*C
1530 P1=0
1540 REM
1550 REM TEST TO SEE IF THERE IS A BALLOON PAYMENT
1560 IF E=0 THEN 1590
1570 REM FINDING PRESENT VALUE OF THE BALLOON PAYMENT
1580 F1=(1+R/100)**-A*E
1590 P2=P1+F1
1600 REM
1610 REM
1620 REM TEST TO SEE IF LOAN AMOUNT - PV IS WITHIN
1630 REM AN ACCEPTABLE RANGE
1640 IF R2=1 AND E>0 THEN D=P2-P1
1650 IF R2=1 AND E>0 THEN P2=P1
1660 IF R2=1 AND E>0 AND C2=0 THEN D=P2-P1
1670 IF R2=1 AND E>0 AND C2=0 THEN P2=P1
1680 IF D-P2<1 THEN 1750
1690 IF D-P2<-1 THEN 1750
1700 IF C9=1 THEN PRINT 'THE YIELD TO MATURITY = 'FNA(B*C5) ' %'
1710 IF C9=1 THEN 1730
1720 PRINT 'THE ANNUAL INTEREST = 'FNA(B*C5) ' %'
1730 GO TO 1820
1740 REM LOWERING INTEREST RATE FOR ANOTHER ITERATION
1750 D=D-(D-P2)/D*.1
1760 REM
1770 GO TO 1500
1780 REM RAISES INTEREST RATE FOR ANOTHER ITERATION
1790 REM
1800 REM
1810 REM
1820 PRINT
1830 PRINT
1840 IF K1=3 OR R2=1 OR C2=0 THEN 2280
1850 PRINT 'DO YOU WANT A LOAN SCHEDULE PRINTED OUT'
1860 INPUT F3
1870 IF F3='NO' THEN 2280
1880 PRINT
1890 PRINT
1900 PRINT
1910 PRINT 'ENTER FIRST AND LAST PAYMENT NUMBER'
1920 INPUT O1,C2
1930 PRINT
1940 PRINT 'THE PAYMENT AMOUNT = 'FNA(C)
1950 PRINT 'THE PRINCIPAL AMOUNT = 'FNA(D)
1960 PRINT 'THE ANNUAL INTEREST RATE = 'FNA(B*C5)
1970 PRINT 'THE TOTAL NUMBER OF PAYMENTS = 'INT(A)
1980 PRINT 'THE BALLOON PAYMENT = 'FNA(E)
1990 PRINT
2000 PRINT
2010 PRINT 'PMT #', 'PRINCIPAL', 'INTEREST', 'REM. BAL.', 'TOT. INT'
2020 PRINT
2030 O1=C
2040 O2=O3=O5=0
2050 O4=D
2060 FOR I=1 TO 400
2070 REM TESTING TO SEE IF THERE IS A BALLOON PAYMENT
2080 IF J<A THEN 2180
2090 IF E=0 THEN 2180
2100 O1=C
2110 REM O3=REM BALANCE TIMES THE INTEREST RATE
2120 O3=O4*(B/100)
2130 O2=O4
2140 O4=0
2150 O5=O5+O3
2160 A8=1+1
2170 GO TO 2230
2180 O1=C
2190 O3=O4*(B/100)
2200 O2=C-N3
2210 O4=O4-O2
2220 O5=O5+O3
2230 IF I<O1 OR I>O2 THEN 2270
2240 PRINT
2250 PRINT 'FNA(O2), FNA(O2), FNA(O4), FNA(O5)'
2260 IF A8=1.1 THEN I=400
2270 NEXT I
2280 PRINT
2290 PRINT
2300 PRINT
2310 PRINT 'DO YOU WISH TO MAKE ANOTHER RUN'
2320 INPUT Y3
2330 IF Y3='NO' THEN 2560
2340 PRINT
2350 PRINT
2360 GO TO 410
2370 PRINT 'ENTER N, PV, FV, COMPOUNDING'
2380 INPUT G,H,I,J,C5
2390 G9=G/C5
2400 FOR Z5=1 TO 2 PRINT
2410 IF C=0 THEN PRINT 'THE NUMBER OF PERIODS = 'FNE(J,I,H)
2420 IF H=0 THEN PRINT 'THE INTEREST RATE = 'FND(J,I,U)
2430 IF I=0 THEN PRINT 'THE PRESENT VALUE = 'FNB(J,C,H)
2440 IF J=0 THEN PRINT 'THE FUTURE VALUE = 'FNC(I,G,H)
2450 GO TO 2280
2460 PRINT 'ENTER # OF YEARS, DISCOUNT RATE, COUPON RATE, PRICE'
2470 INPUT A,B,C,D
2480 C=C/100*1000/2
2490 C5=2
2500 C9=1
2510 A=A*C5
2520 E=1000
2530 GO TO 550
2540 FOR J=1 TO 3 PRINT
2550 PRINT 'P R O G R A M S T O P E D'
2560 FOR I=1 TO 4 PRINT
2570 END

```





# Development System for the 16-Bit PACE Microprocessor

By Phil Roybal

National Semiconductor Corporation, Santa Clara, CA

As the personal computer market has bloomed, there has recently been an awakening of interest in 16-bit microprocessors. Most 16-bit fans will tell you that they chose their particular processor because its performance, minicomputer-like architecture, and powerful instruction set allowed them to quickly and easily run high-level languages or handle number-crunching problems. And those are very good reasons indeed.

Unfortunately, while many factors favor a wider word length than today's 8-bit standard for home computers, one factor has tended to dominate the market: the cost of a system to run that "minicomputer-on-a-chip." A quick glance around the marketplace reveals that the two or three manufacturers presently offering the 16-bit products are asking about twice the price of an equivalent system built around a Z80.

Into this relative vacuum, National Semiconductor has introduced a Low Cost Development System (LCDS) for its 16-bit PACE microprocessor (Photo 1). This industrial-quality unit allows users to develop and debug interface hardware and software for a cost of only \$585. This means that a system with classical minicomputer architecture is within the price range of many computer hobbyists for the first time.

The PACE LCDS is a completely assembled, self-contained microcomputer on a single printed-circuit board. It comes already mounted on its own chassis, and requires only the connection of a power supply (+5,  $\pm 12$ V) to make it operational. The basic configuration of the LCDS (Figure 1) includes:

- PACE microprocessor and support devices
- 1024 x 16-bits of RAM
- DEBUG/MONITOR firmware in ROM
- Sockets for 1024 x 16-bits of user ROM/EPROM
- 20mA current-loop and RS232C serial interfaces
- 20-key keypad
- 6-digit HEX display
- Three expansion sockets for additional memory or interface cards.

In its simplest configuration, the LCDS is a device for manipulating machine language. It has two modes of operation: RUN and DEBUG.

In the RUN mode, the unit provides a monitor function and the PACE microprocessor simply executes the user's program as written. In the DEBUG mode, however, the LCDS operates under control of built-in monitor firmware which permits the operator to communicate with the system through the Control Keyboard and Display (see boxes), or via an optional serial terminal. Either way, the compact assembly affords the user the following capabilities:

- Display contents of PACE registers
- Display contents of any memory cell
- Alter contents of any PACE register
- Alter contents of any memory cell
- Run or single-step through a program
- Set a breakpoint to interrupt execution of a program at any point, preserving status
- Halt a program, preserving status

## LEARNING WITH PACE LCDS

The trouble with most microprocessor systems is that there's too much of them! In contrast, the LCDS' compact design imposes only a bare minimum of hardware between the user and the microprocessor he seeks to master. Thus it becomes an ideal tool for the kind of direct hardware experimentation that will give the individual a feeling for the processor's architecture, possibilities, and limitations.

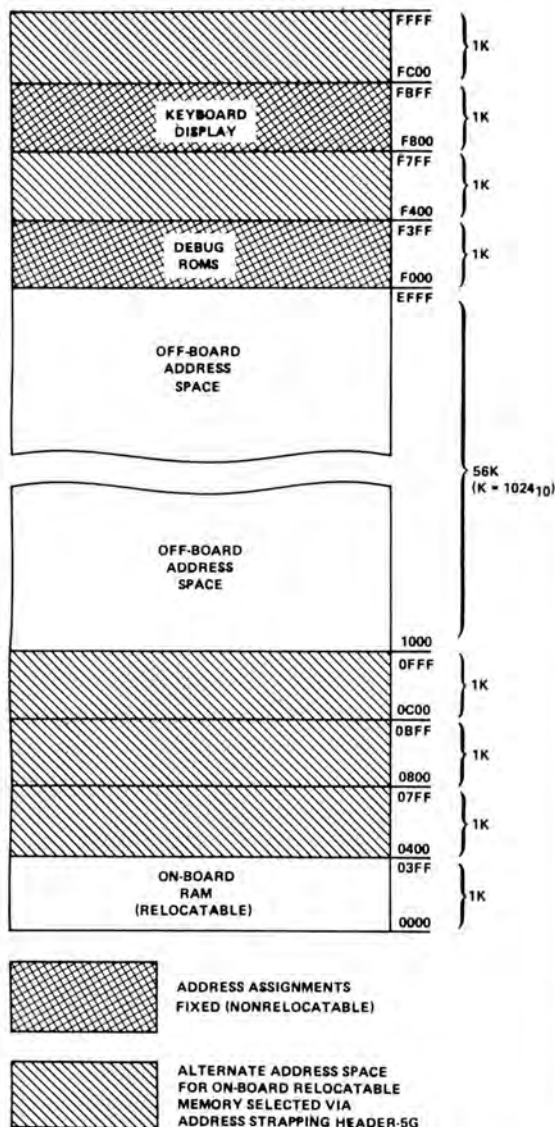
Equipped with the basic unit and an instruction table like that shown in Table A, the system designer can quickly discover the relationships between instructions, addressing modes, and architectural resources of the chip.

The LCDS is particularly well-suited for the novice, or for the user whose primary interest is in the development of interface hardware. It is quite an easy task to build an interface, insert it into one of the expansion sockets on the motherboard, and watch the interface









3a

Key	Description
INIT Pushbutton	Provides initialization signal output over LCDS control bus to initialize PACE microprocessor, LCDS circuits, and any application circuitry utilizing NINIT signal. When pressed during RUN Mode operation, terminates execution of users program and causes LCDS to enter DEBUG Mode. When pressed during DEBUG Mode operation, terminates command in progress and causes LCDS to return to DEBUG Mode entry point. Pressing INIT will also affect the contents of flags, stack, and accumulators; set display to 0000 PC; clear breakpoint; and terminate any trace operation.
RUN Pushbutton	Functional only when LCDS is in DEBUG Mode and KYBD Operation is enabled. When pressed, terminates DEBUG Mode, and causes execution of user program to be initiated beginning at address designated by stored PACE program-counter (PC) value.
HALT Pushbutton	Functional only when LCDS is in RUN Mode (as indicated by RUN light). When pressed, terminates execution of user program (after instruction in progress is completed), and causes LCDS to enter DEBUG Mode. Program status is automatically saved.
ALTER/ENTER Pushbutton	Functional only when LCDS is in DEBUG Mode and used in conjunction with Display Keypad. When pressed, causes ADDR/DATA Display to be blanked, and a prompt indicator (decimal points) to be displayed. Display Keypad then functions as numeric input unit to alter contents of registers or memory locations. Numeric entry is terminated by second depression of ALTER/ENTER.

3b

Key Label/Name	FUNCTION Display	ADDR/DATA Display
AC0/Accumulator 0	A0	Contents of AC0
AC1/Accumulator 1	A1	Contents of AC1
AC2/Accumulator 2	A2	Contents of AC2
AC3/Accumulator 3	A3	Contents of AC3
PC/Program Counter	PC	Contents of PC
NI/Next Instruction	nI	Next Instruction that would be executed (Contents of memory location designated by PC.)
FLAG/Flag Register	FL	Contents of Status and Control Flag Register
STK0/Stack Level 0	SO*	Contents of top word of stack (level-0)
BRPT/Breakpoint	bP	Address of Breakpoint
ADDR/Address	Ad	Address of 'current' memory location
DATA/Data	dA	Contents of 'current' memory location
INCR/Increment	*	Contents of next level of stack, or next memory location, or next memory address

\* Using the INCR key, lower levels of stack can be displayed. FUNCTION Display will indicate level being displayed; for example, S1 for stack level-1, S7 for stack level-7. When INCR is used in conjunction with DATA or ADDR keys, FUNCTION Display will be dA or Ad respectively

3c

Control or Indicator	Description
RUN MODE toggle switch	Associated with RUN Mode operation of LCDS. When set to STEP, enables single-instruction execution of user-entered program; when set to CONT, enables normal (continuous) execution of users program.
DEBUG MODE toggle switch	Associated with DEBUG Mode operation of LCDS. When set to KYBD, enables DEBUG operational commands to be entered via LCDS Keyboard; when set to TTY, enables DEBUG operational commands to be entered via TTY keyboard (or RS-232 data terminal).
RUN Light	On (lit) when in the RUN Mode of operation; off when in the DEBUG Mode of operation.

Figures 3a, 3b, 3c. LCDS controls and indicators are grouped in three separate, but interactive, functioned groups: The mode selection and indicators, the system control keys and the keyboard and associated display.







# SFS WALLETS/ZE



## SPACESHIP SIMULATOR PART 2



*Last month, in Part I, the origin and design of the simulator was presented. This month, in the conclusion of the article, the authors present a discussion of the hardware and software required to make the ship work. This is probably one of the more ambitious projects attempted, using a microcomputer. Hopefully it will inspire many readers to even higher levels of creativity.*

—Editor

## HARDWARE CONSIDERATIONS

The SFS Walletsize required some special hardware and software to be capable of true simulation. Analog controls such as joysticks, and throttles required interfaces which could translate their position into digital information to be processed by the computer. Switches would also be used as input and would need special treatment depending on their ultimate function. The results of the processing also required some preprocessing before they are displayed to the pilot on video screens, instrument panels, telltale lights, and as variable frequency audio tones from several small speakers. A survey on available products was made before we decided to build anything. Price was an important consideration, as was software overhead. Looking back on it, if we were to start over again from scratch, our choice of hardware would be considerably different, since most of our present system had been acquired before the Walletsize project was begun.

Although analog to digital converters were available from several well established manufacturers, we decided to build our own interface cards, due to our interest in exploring alternative methods to the conventional ways of doing things. We also felt that all the special hardware required for the simulator could be built onto one S-100 board, which would simplify the cabling. That would make it easier to later substitute another computer for the one used initially. It was also generally felt that a custom-built board would be useful in other endeavors, where a conventional A-D board might not.

Three high resolution color graphics display modules would have been nice to have; unfortunately, even one such display was prohibitively expensive. High resolution black and white was then considered, but in the end proved to require either high software overhead or staggering amounts of memory. The final decision was to add two PolyMorphic video boards to the one we already had. This configuration gave us both character and graphics capabilities. Although the graphics resolution was coarse, 48 x 128, this was offset by the advantage of having direct graphics manipulation capability from the Poly A00 BASIC\*, by using the plot statement.

The telltale light system was built out of parts on hand. Ultimately this system will provide the capability of controlling up to 128 pairs of lights, using just one 8-bit output port. A simple extension of the hardware, which was designed to do the analog to digital conversion, provided a simple-to-use audio output capability that worked quite well.

## COUNTER TIME BOARD

Our approach to the analog to digital conversion problem was typically unconventional. However, it provided us with the required accuracy and cost us very little. A look at the block diagram of the conversion scheme will help to illuminate this discussion (Figure 1).

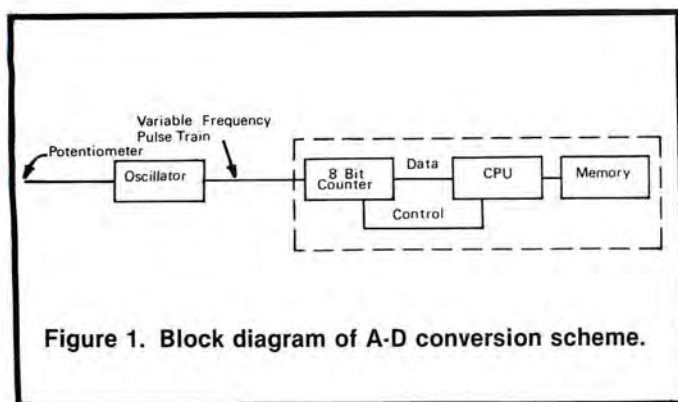
A potentiometer is used to vary the frequency of the pulse oscillator. The signal is then used to decrement an 8-bit counter, over a time interval controlled by the CPU. At the end of the interval, the value remaining in the counter is read by the CPU and is used to compute the current control position. The accuracy of this technique depends mostly on the accuracy and linearity of the pulse oscillator. Low accuracy was acceptable for our simulation and price was the major factor, in choosing the 555 timer IC to build the oscillator. A higher degree of accuracy could have been obtained by a linear voltage-to-frequency converter like the Raytheon 4151, but the cost is higher.

The most important advantage of using this method is the high noise immunity, since the potentiometer was to be located at some distance from the computer. With the operating environment being extremely noisy, we wanted the analog inputs to be as noise immune as possible. Had we used a conventional A-D converter board, the wires from the controls would have required shielding to avoid errors due to the induced noise signals. By contrast, our technique allows for transmission of the signals over a long distance using a single pair of wires in a ribbon cable. This works because the position of the potentiometer changes from an analog signal to a frequency right at the pot; the frequency, not the voltage, is transmitted over the wires.\*

Consequently, for this same reason, accuracy falls off when the period of the oscillator approaches that of the CPU sampling interval. A minimum count must be met to provide a specific accuracy at the lowest frequency. This limits the amount of resolution available from an 8-bit counter, since the maximum count of 255 must be avoided to prevent wrap-around-counter passing through zero. We ended up using a range of approximately 200 counts, sacrificing about 50 counts at the low end for accuracy and about 5 counts at the high end to prevent wrap-around. Another factor in favor of this approach is that the counter provides an average of the

*\*Similarly, FM radio is more noise immune than AM radio. In AM radio (and ordinary A-D methods) the noise is due to the misinterpretation of a noise signal for an intentional signal, since the noise signal appears as amplitude information. In FM radio (and in our counter technique) the amplitude information that represents the noise signal may be rejected by the use of limiting or hysteresis amplifiers (Schmidt triggers). Thus our technique provides a reliable, error free transmission capability over a transmission medium with a signal to noise ratio of 6 dB or less.*





control's position over the interval between readings. This, in combination with the software method chosen for sampling, provides a real time control capability that works with BASIC.

Therefore, six channels of analog input were assembled using this method. Of the six channels, three were dedicated to the control stick where potentiometers were used to encode the two major axis of motion, and a third potentiometer was used to encode the twist of the shaft on the stick. The other three channels of analog input were used on three slide controls of the type usually seen in audio mixing equipment; these were to be defined as our throttles.

We were going to build the counter channels using MSI TTL technology and purchased several chips for this purpose. Fortunately, before work began, we discovered the Zilog CTC™, a programmable counter which included more capability on one chip than we could have gotten on a whole circuit card full of MSI TTL counters and registers. We were able to build four CTC chips, 16 counter-timer channels, and their support circuits onto one half of an S-100 prototype board. This design left the other half free for interface circuits, or other devices such as parallel ports.

### COUNTER-TIMER BOARD ASSEMBLY

The counter-timer board was assembled on a Vector 8800V microprocessor prototype board using a Vector wiring pencil. The counter-timer chip, made by Zilog and Mostek, provides several operating modes which can be controlled by software. Unfortunately, the chip is designed for interface to the Z-80 bus, not the S-100 bus. Therefore, interface logic must be constructed to decode the states of the S-100 bus to provide the proper

control signals to the CTC chip (Figures 2 and 3). With the layout shown for the circuits (Figure 4), 4 CTC chips (16 channels total), can be assembled onto one half of the prototype board. We chose the Vector wiring pencil method because it permitted integrated circuits to be mounted very close together, where other wiring methods required more space between sockets.

The circuit which allows the CTC chip to work with the S-100 bus is fairly simple. However, tri-state buffers must be used on the bidirectional data lines for the S-100 bus. This is accomplished using three 8097 tri-state HEX buffers. Buffering and inversion were also used on the eight I/O port address line to allow maximum flexibility in address reassignment.

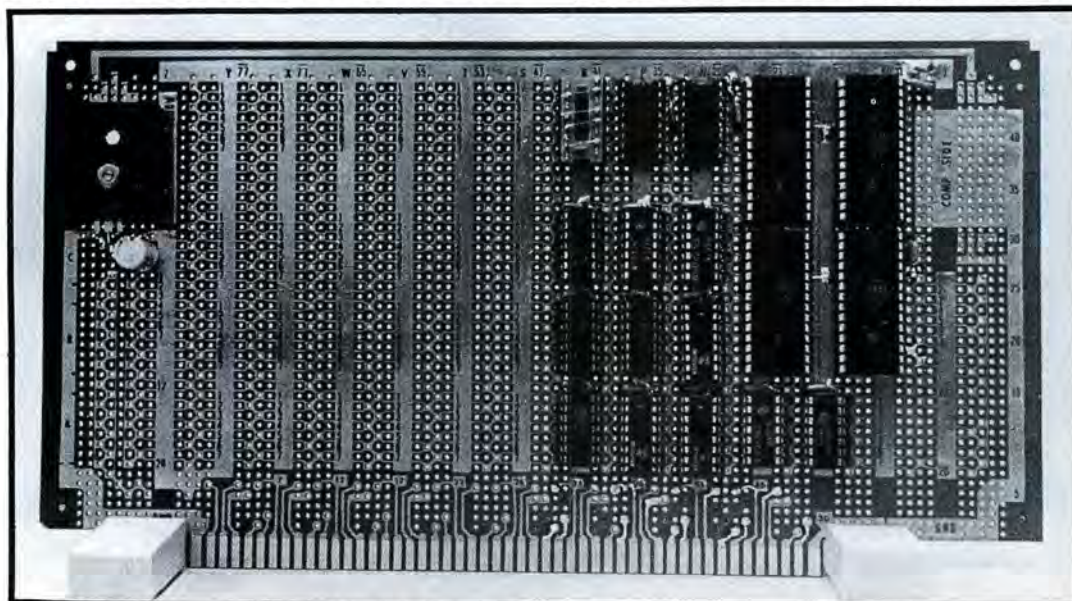
When assembled as shown (Photo 1), the CTC channels occupy 16 consecutive I/O addresses in an even block (30, 31, 32, . . . 3F). Address bits 1 and 0 are used to select the counter channel within the chip. Address bits 2 and 3 are used to enable one of the four chips. Address bits 4 through 7 are used to select the address block.

The CTC chip requires several signals which are not present on the S-100 bus; therefore, we had to create these signals from ones which were easily available. The first is IORQL. This signal can be derived easily from a NOR function of the SINPH and SOUTH signals,  $IORQL = SINPH \text{ NOR } SOUTH$ . Several signals are simply inversions of those available on the S-100 bus; i.e.,  $RDL = \text{NOT } PDBINH$ ,  $MIL = \text{NOT } M1H$ ,  $\text{Clock H} = \text{NOT } \text{Clock L}$ .

The address lines 0 and 1 select the channel using the CTC signals CS0 and CS1. There is only one CTC signal left, CEL, the signal that enables the interval tri-state buffers for data bus transfers. From the appropriate address buffers and the IORQ signal we create this final signal individually for each chip. Consequently, each chip is enabled only when the correct address is on the bus during an input or output cycle. A combination of these signals is also used to enable the data bus buffers feeding the S-100 bus. The two NOR gates wired as inverters in that signal chain are to allow for future expansion into other address space when circuits are added onto the other half of the card. The input and output pins from the CTC are wired to dip sockets for ribbon cable connection to the Walletsize interfaces. A 7805 regulator is used in the conventional manner for a +5V power supply.

### CONSOLE INTERFACE BOARDS

The console interface boards are mounted inside the port and starboard consoles, (Photos 2 and 3). For sim-



**PHOTO 1 Assembled analog interface card.**



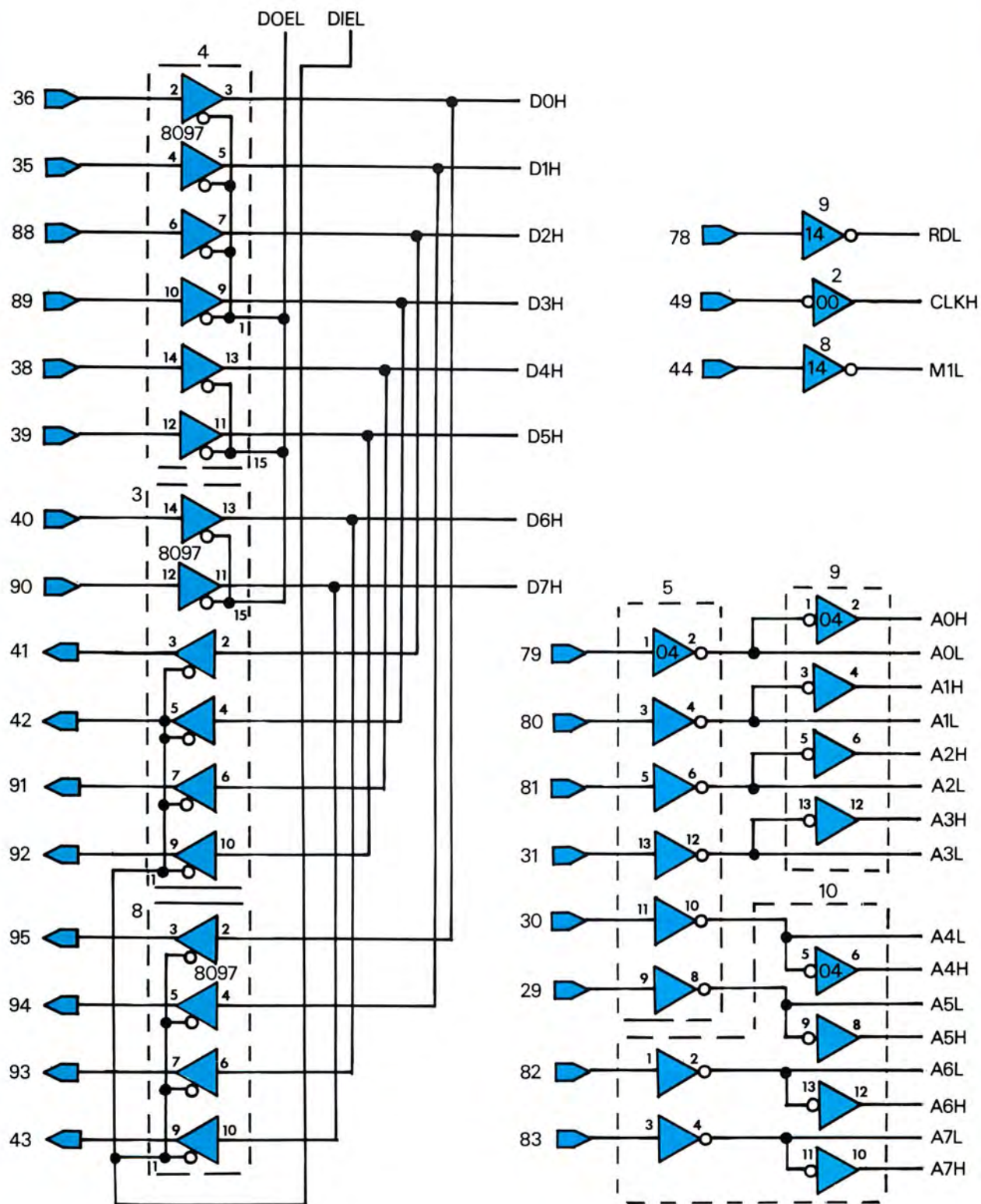


Figure 2. S-100 bus homebrew analog interface card I/O buffer schematic.



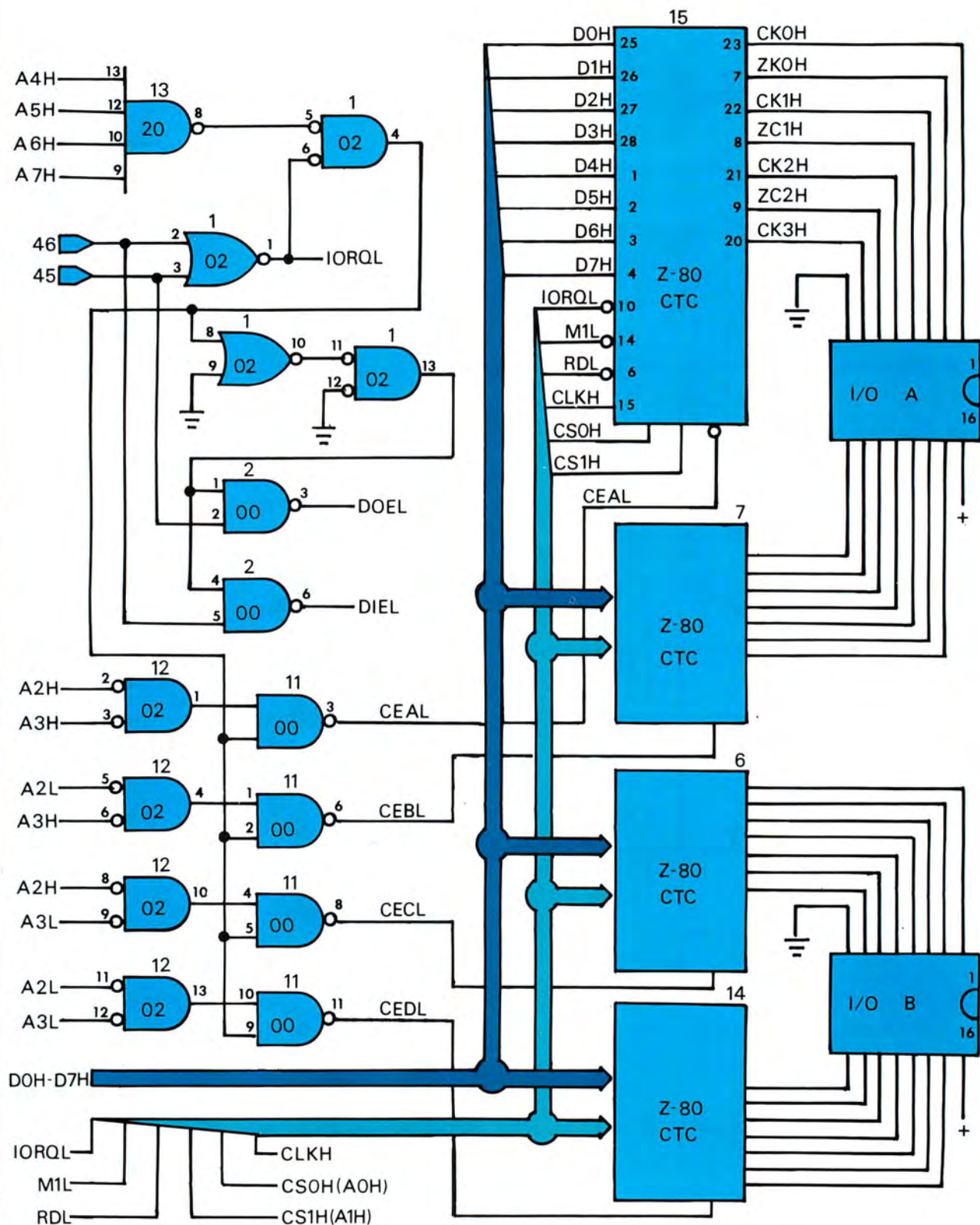


Figure 3. S-100 bus homebrew interface control circuit schematic.



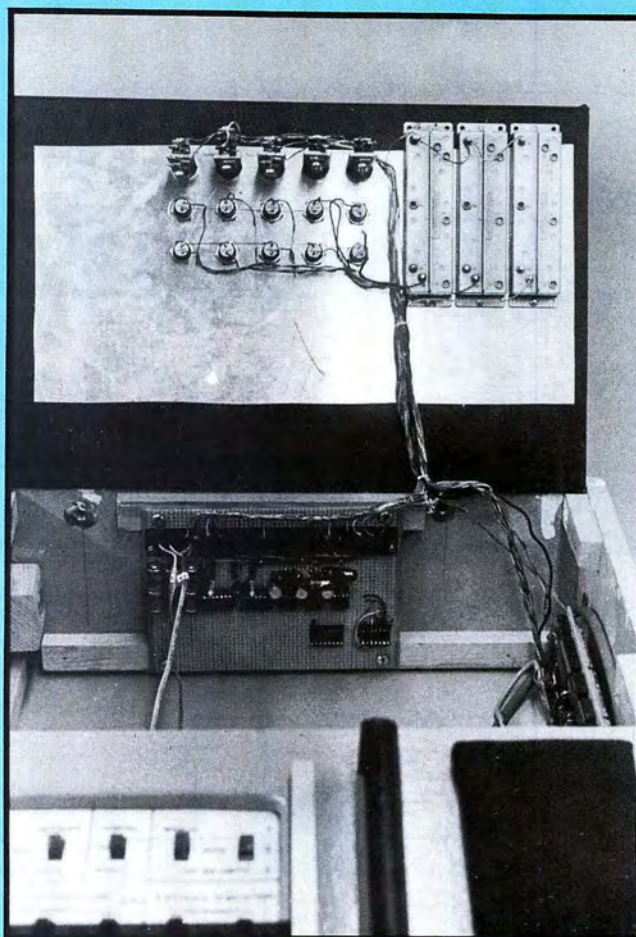
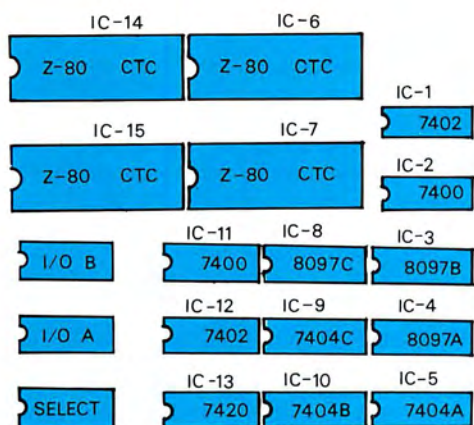


PHOTO 2 Port console showing: Interface card, switch, lamp, and potentiometer wiring.

Figure 4. S-100 bus homebrew analog interface card layout.

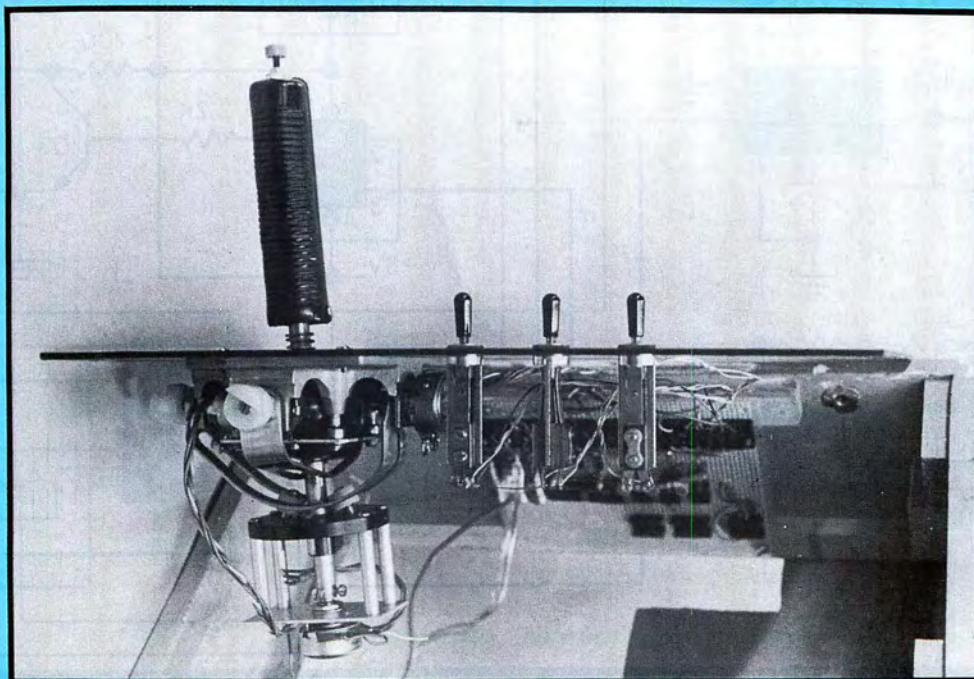


PHOTO 3 Starboard console showing joystick switch and wiring.



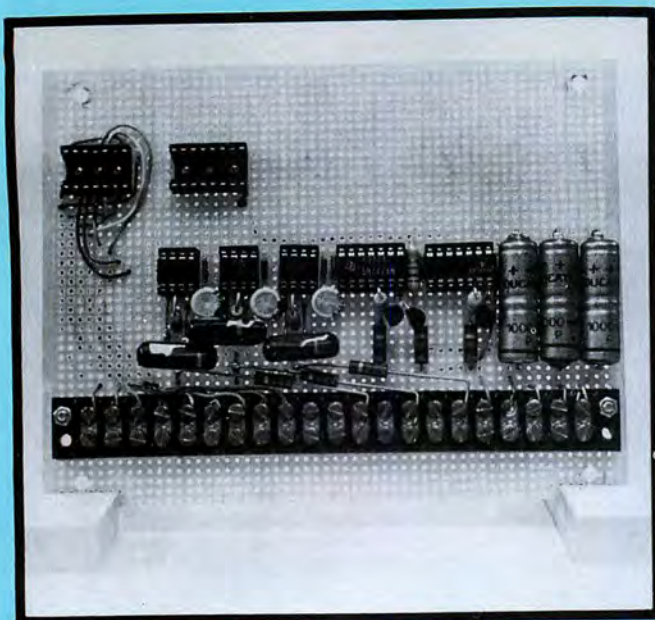


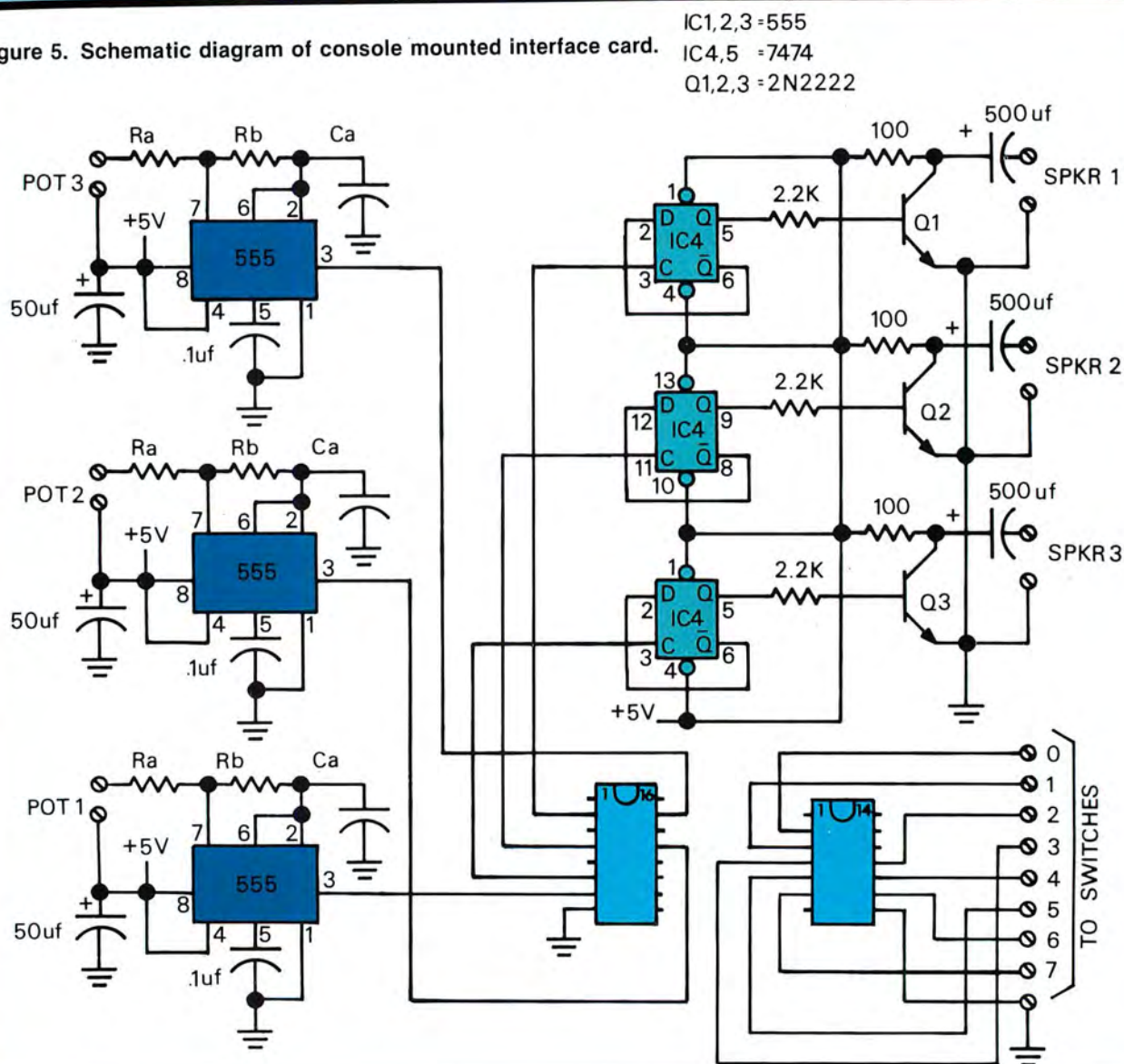
PHOTO 4 Component placement on interface card.

plicity, two identical boards were built, each one providing circuits to interface three potentiometers and three small speakers. In addition, each of these boards has wiring to bring the connection for a parallel port up to a barrier strip from the dip connector used for computer interface. When in service, this board is connected to the computer through two ribbon cables and to the potentiometers, switches and speakers through the barrier strip. These boards were wired with the Vector wiring pencil, and some point-to-point insulated wires.

The 555 timers were wired in the astable configuration, with one of the timing resistors replaced by a potentiometer. With the proper choice of components, this oscillator can cover a frequency range of over 1000 to 1. The potentiometer used, however, must be log or anti-log taper in order to get reasonable linearity from the final count. After initial calculations, the final resistor and capacitor values were established by the cut, try and fly method. The 7474 dual D flip flops are wired to divide the input frequency by two, providing a symmetrical output waveform. The output of the flip flops drive transistors for increased current output capability (Figure 5 and Photo 4).

The requirements for the lamp control circuits for the Walletsize were also somewhat unusual. The most im-

Figure 5. Schematic diagram of console mounted interface card.





portant parameter was cost. As a result, we were forced to avoid the expense of the DC supplies which would have been required had we taken the conventional approach. Since most of the lamps were already in place when we purchased the surplus panels, we had a combination of voltage and current ratings, which would have required several large DC power supplies. We developed a lamp control board which would work on AC, thus solving our problems with a few low cost tapped transformers. We simply substituted SCRs for the transistors which would usually be used for lamp drivers (Photo 5).

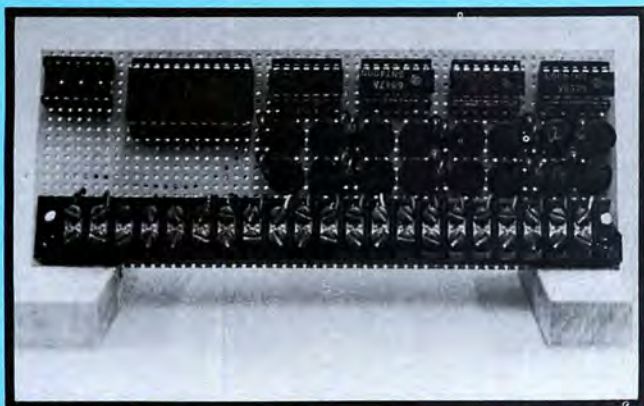


PHOTO 5 Component placement on lamp driver card.

Another requirement of the lamp control drivers electronics was a minimum of hardware and software overhead at the computer. To comply with the software requirement, we designed the interface to set and reset flipflops, with each flip flop being individually addressable. Consequently, to turn on a lamp, it would be necessary to send the proper control code to the one 8-bit port. To simplify the overall hardware required to control the maximum number of lamps, we wired both outputs of the flip flops up to SCRs. This allowed for two lamps to be controlled by each flip flop, one on, the other off. This seemed appropriate, since many displays require red/green status reports. Since the lamps were located in separate modules, the circuits were built to be located close to the lamps, and to be connected together by a daisy-chained ribbon cable which supplied the computer output.

strobe is required to support on/off control of up to 128 flip flops or 256 lamps. If less than this is required, the lamp display electronics can be simplified since each decoder can be enabled directly from a bit instead of from an address selector, as shown in Figure 6. The display board was assembled this way. The board uses one of the 4 most significant bits to enable its decoder. The 4 least significant bits are wired to the decoder inputs and brings one of its 16 outputs low while the strobe is present. The even outputs of this decoder are wired to the reset inputs of the flip flops and the odd outputs are wired to the set inputs, so that when one of the decoder outputs goes low it will force the proper state at the flip flop. This will raise the gate of one SCR to a logic high and force the other to a logic low. For the SCRs chosen, these logic levels were sufficient to trigger the SCRs.\*

*\*You should confirm this if you substitute components. We do not recommend any attempt to control 110V AC from the mains without use of at least an isolation transformer. Opto-isolators should be used for interface to the SCRs as well when the voltage is appreciably higher than the ones we used.*

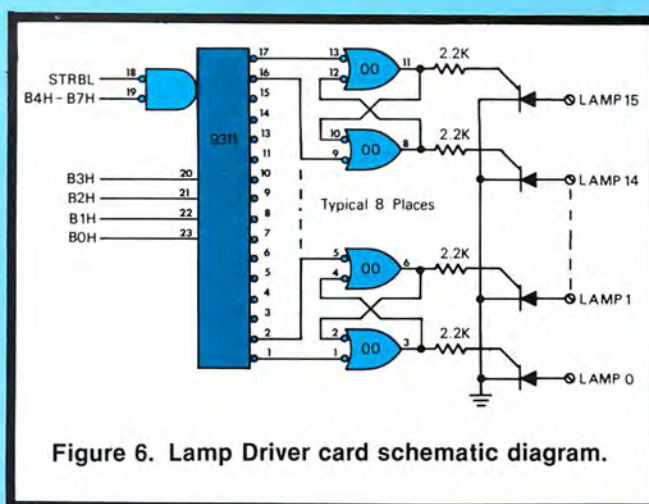


Figure 6. Lamp Driver card schematic diagram.

## MAIN DISPLAY BOARD MODIFICATIONS

Of the three PolyMorphic Systems video boards used in the Walletsize, two were of the Rev.1.2 variety, and one of the Rev.0.1 style. The older one, the Rev.0.1, has been in our system for over a year and has been extensively modified for other functions. So we decided to use it for the large central video monitor. One of the modifications, the retrace interrupt, isn't often mentioned, so we will examine it in more detail.

Most video boards work in the same manner, a section of random access memory is shared by two processors. The main processor is usually the system CPU, which can read or write to this shared RAM at any time. The second processor reads this RAM and encodes its contents for video display. Usually, the video processor cannot access the shared RAM at the same time that the CPU is using it, resulting in black or white flashes or partial loss of sync. We found this to be very annoying when it occurred on the main screen, and set out to do something about it.

After considerable experimentation, it was discovered that the video disturbances could be avoided if the main CPU did all transfers to and from the screen memory, during the time that the vertical retrace was occurring. This amounts to about  $\frac{1}{1000}$  second and occurs every  $\frac{1}{60}$  of a second. This signal can be used in several ways for software synchronization of screen memory access, so there are several hardware modifications which can be made. The simplest of the possible modifications is wiring this signal to one bit of an input port. The disadvantage of this method is that all video access software must wait for the proper time by testing this bit in a WAIT loop. Another simple method for synchronizing the software for video access uses the retrace signal to generate an interrupt, with an interrupt service routine handling all transfers. This works better, but is still not quite the answer because the interrupt request cannot be cleared by the service routine. This makes the service routine awkward since it must wait for the signal to become inactive before returning to the foreground program.

The best solution we've found to this problem is to use this retrace signal as the strobe for an 8-bit input port, with the input port device itself requesting the interrupt. The input port can be read by the software to clear the interrupt request, and another will not occur until the next retrace interval. Since this vertical retrace signal occurs every  $\frac{1}{60}$  second, we use it as our real time clock interrupt, and link in the retrace service routines under software control. The 8 bits from this input port were also used for switch inputs, and were written to a memory location when the port is read by the CPU.

The hardware chosen for the SFS Walletsize and described in this article, accomplished a major portion of



the simulation task. Therefore, the CPU would be free most of the time to execute BASIC. By contrast, all of the above hardware functions could have been simplified, but then the major burden of the CPU would have been the increased software overhead, required to simulate the hardware. Even with most of the tasks being handled by hardware, a considerable amount of special software is still required for control of the hardware devices.

## SOFTWARE REQUIREMENTS

The software task for the SFS Walletsize was simplified considerably by the choice of Poly A00 BASIC™ for the operating system. Poly BASIC provides for machine language subroutine calls, peek and poke functions, in and out statements, and a plot statement which directly manipulates the graphics cells on the Poly video board. These capabilities allowed us to extend the BASIC with our own customized machine language program segments, when a BASIC algorithm would have been slow or clumsy. Also, the Poly A00 BASIC has a well defined I/O structure which made the task of interfacing new devices very simple.

Even though BASIC is ideal for a great number of software solutions, it does have its drawbacks for real time programming. Since BASIC is an interpreted language, it runs slowly in comparison to a compiled language. BASIC is not capable of handling the interrupt structure as high level code. To get around this problem, we wrote a machine language interrupt structure with additional machine language control structures for use in BASIC call functions.

In the SFS Walletsize, many devices are controlled by the real time clock service routine, a machine language program which is executed every 1/60 second. When this routine executes, it performs the input or output functions for the device, using memory bytes as a communications linkage for the data to be shared with BASIC. Since this real time clock service routine is an interrupt routine, its execution is under hardware control and it can be thought of as executing transparently underneath BASIC. Since it executes every 1/60 second, it can catch many events which would occur too fast for BASIC, and can be used as a timebase for integrating analog to digital converters. The service routine can perform other functions such as averaging, real time clock splits, and latching of data into memory bytes, thus simplifying the software task which BASIC would otherwise have to perform.

The only other machine language programs used in the Walletsize are the display handling subroutines, used to simplify the problem of handling three separate video screens from BASIC. These subroutines are built from the Z-80 block move instructions and are used to compose displays into a video buffer, where BASIC can print or plot into them before other block move subroutines move them to the appropriate video screen. A number of different displays are stored in the machine's memory prior to the simulation, to be used in the composition of various video displays.

A number of compromises in software methods, most of them contrary to the usual concept of structured programming, were necessary so that the final simulation would run fast and smooth. Some of these compromises are as follows: Write the BASIC program as one main loop; avoid for-next loops within the main loop; squeeze as much as possible onto one statement line; minimize decision making within the main loop; use variables instead of constants inside the main loop; use GOSUBS and function calls sparingly, they take more time than straight line code; don't use wait loops to establish timing, process data instead; when feasible, use machine language calls instead of time consuming BASIC loops.

## SOFTWARE STRUCTURE

The accompanying flow chart (Figure 7), shows the way the software jobs were divided between the various program structures. As shown in the chart, the software breaks down into three sections: A BASIC program which performs calculations, decisions and other major computing jobs. It is also the main control structure for the two following groups. Machine language subroutines, called from BASIC, which control the interrupt structure and others which handle large blocks of data. Interrupt service routines which perform some predefined function upon receipt of a hardware signal. These are executed transparently to the execution of the previous two groups.

Each of these three groups needs separate discussion, before we can illustrate how they work in concert to provide a complete simulation. First, let's examine the interrupt structure, since it is fundamental to the understanding of the whole system.

## INTERRUPT STRUCTURE

The system hardware uses vectored interrupts, to cause initiation of a machine language subroutine, beginning at one of eight possible locations. Although this action occurs as the result of a hardware condition, the action is similar to the action of one of the 8 restart instructions in the 8080 set. In our system, one of these, restart 0, is reserved for system reset. We are left with seven locations where an interrupt service routine can begin. Since an interrupt can occur at any time, interrupt service routines must not alter any of the CPU's registers. They are therefore saved on the system stack, the program counter has already been saved on the stack by the RST instruction. As an example, let's examine a simple real time clock routine which supports an eight bit timer.

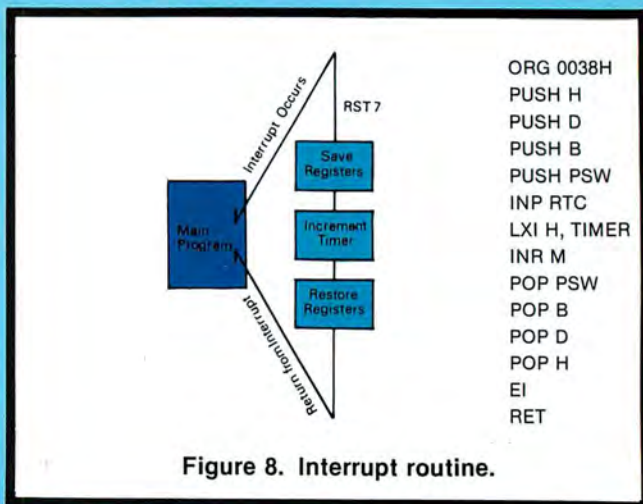


Figure 8. Interrupt routine.

This example, although very simple, illustrates the point. The main program could be any program running with interrupts enabled. When the interrupt request signal is received, the processor disables interrupts and generates an interrupt acknowledge signal. This signal allows the restart instruction to be placed on the data bus by the vectored interrupt hardware. The processor then treats this restart instruction as its next instruction and begins the sequence by saving the program counter on the stack. Execution then continues at the restart vector implied by the instruction. In our example, this vector would be restart 7 and the CPU would begin to execute the above sequence by saving its registers with the first four instructions. First the interrupt service routine, using the input instruction, must reset the signal which starts the series. Note: this input instruction does not



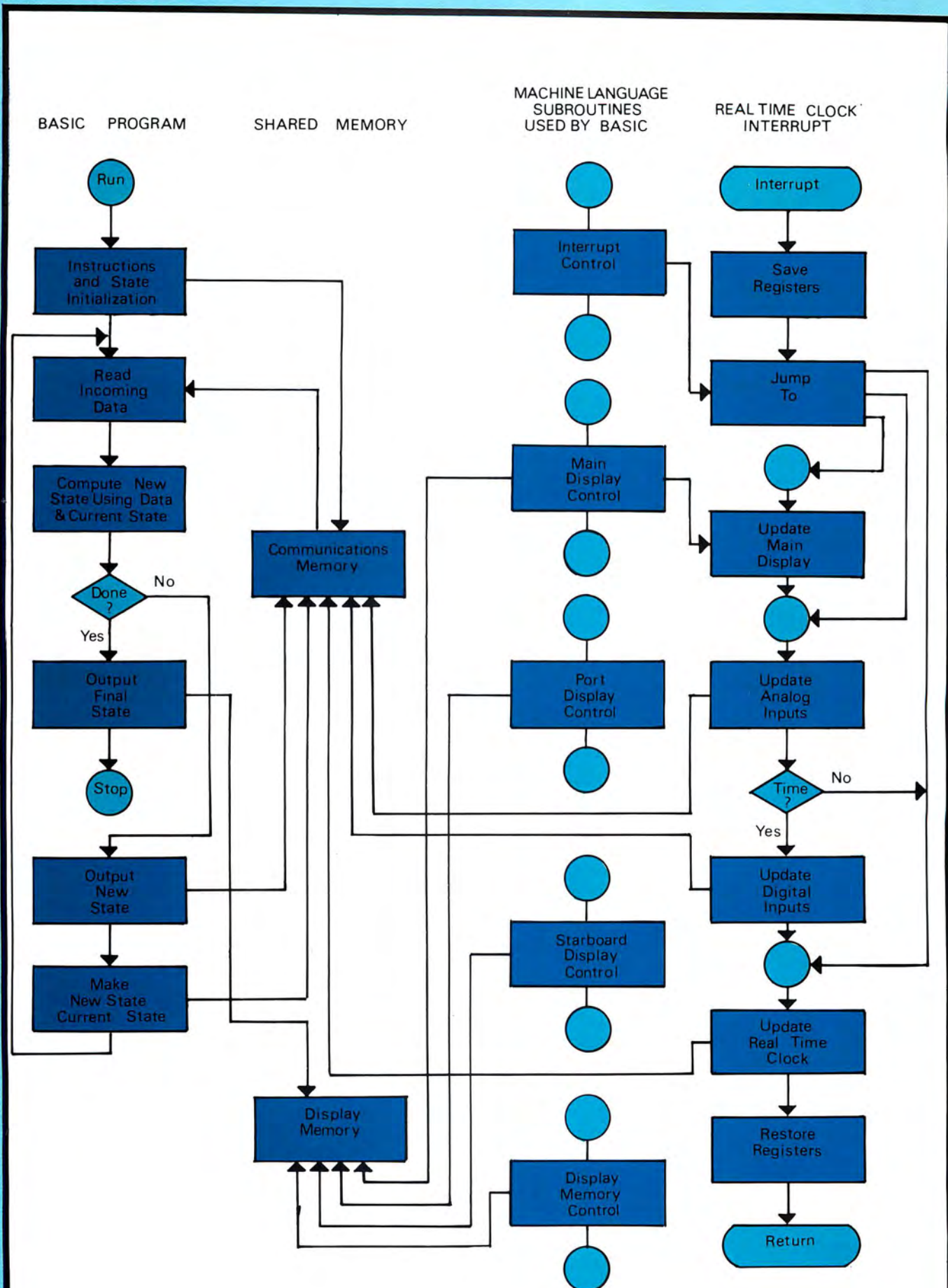


Figure 7.



read anything, it merely resets the interrupt request flip flop on the real time clock. The HL register is then loaded with the address of the timer byte and the contents of the timer byte itself is incremented by the INR M instruction. The next four instructions restore the old register contents to the CPU and the remaining two instructions, EI and RET, will return control to the interrupted program; it will continue until the next interrupt comes along.

Additional precision can be added to this timer by dedicating more than one memory byte to use as registers, and adding a small loop to the interrupt service routines, to address and increment them as required.

To maintain compatibility with PolyMorphic's software, which uses the 4.0 monitor, and to allow maximum capability for program expansion, we do not actually run the programs in the Poly ROM. Instead, we copy them first from ROM to RAM and then we run the RAM copy. This allows us to patch or modify the code in the ROM routines as we bring the system up to final configuration. One of these modifications is the address field in the jump instruction for the real time clock service routine. The real time clock interrupt, in our system, is derived from the vertical retrace interval of our main video board. Occasionally we want to use it to move data from some other area of memory to the video screen memory. To do this, the video service routine had to be linked into the clock service routine.

## VIDEO SERVICE ROUTINE

The video service routine is intended to work during the vertical retrace interval. Therefore, it has been written to transfer an exact number of bytes on each interrupt, so that the transfer is over before the next video frame is started. The video service routine must also be the first service routine executed after the interrupt occurs. So we stack it onto the front of the service routine chain. Through calculations we determined that 128 bytes could be transferred during each vertical retrace interval. The service routine was designed to refresh the video memory using eight successive retrace intervals ( $8 \times 128 = 1024$ ).

Since this routine is an interrupt service routine, some method of communication with the foreground process must be established. The requirement can be satisfied by two quantities: First, a 16-bit quantity, which represents the address of the start of the 1024 byte block, which will be transferred to the video memory. Second, an 8-bit quantity acting as a flag to inform the foreground process that the video refresh is complete. The service routine itself is not very intelligent. Once started, it will continue to refresh the video memory every 8 real time clock periods until disabled by the foreground process. A few Z-80 instructions could not be translated by our 8080 assembler; in these cases the op-codes were entered as data bytes, and the Z-80 mnemonic is in the comment field. The actual service routine is between lines 0110 and 0360 of the accompanying assembly listing.

In line 0110 the interrupt request is cleared by the input instruction and in line 0120 the quantity received from the port is saved for later use. In lines 0130 and 0140 the data from another input port is acquired and saved for future use. These ports represent the switches on the port and starboard consoles of the Walletsizer. In line 0150, the HL register is loaded with the address which represents the start of the video memory. The next two lines, 0160 and 0170 represent a single Z-80 instruction which loads the BC register with the offset for the 128 byte block to be transferred on this interrupt. This value is saved on the stack in line 0180, added to

the contents of the HL register in line 0190 and the results placed in the DE register by the SCHG instruction in line 0200. We have thus formed the address in the video memory where the 128 byte block will begin and placed it in the DE register. In the next instruction, on line 0210, PUSH IX saves the contents of the Z-80 IX index register on the stack. This is one of the places where the convenience of using an 8080 BASIC on a Z-80 processor becomes evident. Since the IX register is never used by the foreground process, we can dedicate it as a communications link between foreground and background processes. Here, the IX register contains the 16-bit quantity which represents the address of the memory block which will be transferred to the video memory by the video service routine. In line 0220 we pop this value from the stack into the HL register and in line 0230 add the offset for the 128 byte block which is still in register BC, thus forming the address within the source where the transfer will begin.

On line 0240 the BC register is then loaded with the byte count for this transfer (128 bytes); this quantity is also saved on the stack for later use. Line 0260 is a Z-80 instruction, LDIR, which performs the actual block move of all 128 bytes in one instruction. This LDIR instruction takes several hundred machine cycles to complete the transfer, but it does operate several times faster than an 8080 loop performing the same operation. Line 0270 pops the transfer block size from the stack onto register BC and line 0280 pops the current offset into the HL register. They are added in line 0290 to form the new offset lines 0300 and 0310 test the result. The JNZ instruction in line 0320 skips the next two instructions if the new offset is less than 1024; otherwise the 1024 byte transfer is complete and the HL register is cleared to zero in line 0330 and the flag is made non-zero in line 0340. Execution continues in either case in line 0350 where the offset is replaced in memory by the contents of the HL register. The final step is the exit from the video service routine in line 0360 where control is transferred to the A-D converter service routine.

## ANALOG TO DIGITAL CONVERTERS

The overall method chosen for the analog to digital converters required the CPU to establish the time base for the counter channels, with software commands to the Z-80 CTC chips. Since BASIC cannot provide an exact timebase while executing a segment of BASIC program, the timebase for the A-D converters was also linked into the real time clock service routine. This of course meant that the communication between the devices and the CPU would be in the background, or interrupt, structure. Therefore, an additional communications link between the background and foreground, BASIC, programs was established.

The A-D service routine writes to memory bytes, which are read by BASIC statements. A PEEK instruction is used to read a memory byte when a control's position is required. During the read portion of the A-D service routine, the new input value from the device is also averaged, using the old value from the previous A-D service. This enhances noise rejection and provides a reasonable control lag. This communications link and averaging was easily achieved with assembly language programming methods. Consequently, examination of a few more lines of the assembly listing are in order.

On line 0640, the A-D service routine begins by loading the HL register with the address of our first communications byte. Then the device is read, using the input instruction in line 0650, and the data is added to the contents of the communications byte, with the ADD M



instruction in line 0660. The accumulator and the carry bit are rotated right in line 0670 to accomplish a division by two. The result is stored back in the communications byte by the MOV M,A instruction in line 0680. Finally, the HL register is incremented by one, in line 0690, to point to the next communications byte. The process is repeated for the remaining five A-D input channels.

After the A-D channels have been read, they are re-initialized and set back to counting, until the next time through the service routine, using a sequence of control bytes sent to each device. The assembly language program which does this begins at line 0950 and continues through line 1150.

At this point you will probably notice that some of the assembly language, for the A-D converters, could have been accomplished using a loop or subroutine to make the program code shorter. In our case, however, we wanted to avoid the extra time required for the decision, and transfer of control operations. We also had plenty of memory available for the program, so all the service routines were written using straight line sequences of instructions. This is most notable in some of the codes to follow, where the switches from the consoles of the Walletsize are processed.

---

## These machine language calls have saved a lot of time in the simulation . . .

---

### LAMP CONTROL

The device communications for the output port, used by the lamp circuits, was also linked into the real time clock module to accommodate the hardware and software peculiarities in our system. In Poly A00 BASIC, the OUT statement does what you would expect over most of the address space. That is, direct output to an output port. A small part of the address space has been reserved for system use, to provide extended I/O functions to BASIC. The OUT statements do not provide direct I/O on these ports. The port we picked for lamp control was in the middle of the reserved space, and could not be read-dressed without considerable grief. This was no problem, as the restriction only applies to the OUT statement in BASIC, not to the OUT instruction in assembly language. The port can be accessed indirectly via a POKE statement, on a memory byte, which will be read and output by assembly language. This is what happens on lines 1160 and 1170 of the assembly listing. The hardware problem, lack of a proper strobe on the 8212 output port, was overcome by a connection to the real time clock port.

### SWITCH PROCESSING

The ports which bring in the switches from the consoles of the Walletsize are read and saved for future use. Since the switches are each 1 bit from two 8-bit input ports, some sort of bit manipulation capability would be required to decode each switch individually, from the 8 bit quantity. Poly A00 BASIC has no bit manipulation capability, and a BASIC function or subroutine would

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## IN APRIL THINK ROBOTS



run too slowly for the simulation. Therefore, some sort of machine language assistance which would translate each bit in to a byte was in order. BASIC could then use the PEEK function to test the byte. Once again it proved to be useful to hook this up to the real time clock service routine. The byte could then be managed in real time, thus catching events which the slower BASIC could not handle.

This approach was very simple to use, and allowed switches to be defined as latches, flip flops, incrementing or decrementing real time clock splits, and several other logical functions. For our purposes, it was determined that the switches on the port console of the WalleSize would be best implemented as latches. Those on the starboard console would be dedicated as incrementing real time clock splits. It was also determined that the service did not need to be accomplished on each real time clock interrupt. So the least significant byte of the real time clock timer bytes would be tested and service bypassed when the test failed. Let's examine the assembly listing again to illustrate the assembly code used for the switch processing.

In line 1180, the accumulator is loaded with the least significant timer byte and in line 1190 the least significant 4 bits are masked to test for zero. If they are not zero, the JNZ instruction in line 1200 transfers control out of this service routine to the real time clock service routine. If the bits are all zero, the switch processing would begin in line 1220. The data is then moved to the B register, in line 1220, and the accumulator is cleared by the XRA A instruction, on line 1230. The next instruction, on line 1240, is a Z-80 instruction which rotates the B register left, shifting one of our switch bits into the carry bit. This carry bit is subtracted from the accumulator, which contains zero, in the next instruction, on line 1250. If this switch bit was set, the accumulator will contain zero. In line 1260, the accumulator is ORed with the contents of the memory byte at the address contained in register HL. The result of this logical OR is placed back into the byte by the MOV M,A instruction on line 1270. This series of operations serves to latch the switch into a data byte so that any activation of the switch will remain latched, until BASIC has read the byte and reset it using a POKE statement. The HL register is incremented on line 1280 to point to the next byte. The process is repeated seven more times to service the remaining seven switch bits. This straight line code begins in line 1290 and continues through line 1700.

The incrementing real time clock splits, which were to be used for the switch inputs on the starboard console, were fashioned in a similar manner. Each of the eight bytes in memory would be incremented every sixteenth real time clock interrupt, if the associated switch were set. They would not be incremented if the associated switch were reset. The code which does this is detailed in the assembly listing beginning at line 1710.

First, the switch data is retrieved from memory, where it was temporarily stored when the service was begun. In line 1720, the data is moved into the B register. The accumulator is cleared by the XRA A instruction, on line 1730. Again, the B register is shifted left so that the first switch bit is shifted into the carry bit by the RLB instruction, listed at line 1740. This time, however, the carry bit is added to the memory byte by the ADC instruction, on line 1750. The result is moved back to the memory byte by the MOV M,A instruction on line 1760. On line 1770, the HL register is incremented and the process is repeated for the other seven switch bits by the remaining assembly language down to line 2110. On line 2120, the jump instruction transfers control unconditionally out of this module and into the real time clock service

routine, in the Poly 4.0 monitor, where a 32-bit timer is maintained. The real time clock service has ended the service routines, and the registers are restored from the stack. Return is made into the foreground program which continues unaware of having been interrupted.

This is the end of the discussion of the interrupt structure, with the exception of details of control and communication which will be given in the remaining text on the machine language subroutines and the BASIC programs.

---

## ... some sort of bit manipulation capability would be required ...

---

### MACHINE LANGUAGE SUBROUTINES

PolyMorphic Systems A00 BASIC provides a call function which allows the user to call a machine language subroutine directly from a BASIC statement. This facility also provides a linkage capability between BASIC and the machine language, since a quantity can be passed back and forth with the CPU registers. The way this is done can be illustrated with a small example:

**10 X = CALL (1024, 48128)**

This statement in BASIC will call the machine language subroutine at address 1024 with the quantity 48128 in the DE register. When a return instruction is encountered, in the machine language program, the quantity that is in the HL register will be passed back to the variable X in the BASIC statement. These machine language calls have saved a lot of time in the simulation, by substituting for long or awkward sequences of BASIC statements. They provide for control of the interrupt structure and, in combination with the Z-80, block move instructions, for all video updates.

Since the interrupt system is still fresh in your minds, let's get the control subroutines out of the way first. When the system has just been brought up from ROM and tape, the only function linked into the real time clock interrupt is the timer in the Poly 4.0 monitor. It is up to the basic program link in the video service and A-D service routines. This can be done in a variety of ways.

The main video service control subroutine START, which begins at line 0000 on the assembly listing, takes care of a number of interrupt control functions, which would be awkward or difficult in BASIC. First, the contents of the DE register are placed on the stack and popped from the stack into the IX register, on line 0010. This links the parameter passed from BASIC into the IX register, where the video service routine will use it as the source address for the video refresh. On line 0020, the HL register is loaded with zero and the SHLD instruction, on line 0030, stores the HL register into the offset for the video service routine, to reset the routine back to the start of the first 128 byte block, in both the source and the video memory. The accumulator is cleared by loading a zero into it, on line 0040, which is stored into the foreground-background flag by the STA instruction, on line 0050. Remember, the flag is made non-zero by the video service routine when it has completed the video refresh, by moving all 8 128-byte blocks from the source memory to the video memory. Finally,



on line 0060, the HL register is loaded with the address of the video service routine, and line 0070 stores this address into the address field of the JUMP instruction in the real time clock service routine, diverting the real time clock interrupt into the video service routine. Control is returned to BASIC by the RET instruction, on line 0080, and BASIC continues on unaware that video refresh is occurring, during the real time clock interrupt.

The next subroutine we shall examine is the one which turns off the video service routine, but leaves the A-D service routine still linked in STOP. In Line 0370, the HL register is loaded with the address of the entry point for the A-D converter service routine. This address is stored in the real time clock jump instruction, by line 0380. The RET instruction which follows, in line 0390, returns control to BASIC.

Both these subroutines are used inside of another subroutine, ONCE. ONCE starts the video retrace and waits until it is complete before returning to BASIC. This subroutine starts at line 0400 in the assembly listing, with a call to the video retrace start subroutine, in line 0410, the accumulator is loaded from the communications flag. This flag value is tested, in line 0420, by the logical OR instruction, for a zero condition. As long as the flag is zero, the JZ instruction, in line 0430, loops back to load and test the flag again. When the flag fails the test for zero, the video service routine has been run eight times, on eight successive retrace intervals, to write the entire video screen. So the call instruction, on line 0440, calls the subroutine which stops the video service. Again, control is returned to BASIC by the RET instruction on the next line.

This subroutine is also called by a still further subroutine, NUSCRN. NUSCRN moves a specific memory area to the main screen. This subroutine is in the listing at line 0460 and requires no explanation here. It will be covered in the next section on the video animation subroutines.

## VIDEO ANIMATION SUBROUTINES

The method for video animation is crude, and lacks the sophistication possible with more complex software. However, it does permit BASIC to run three video screens, with updates in less than a second. This is accomplished by setting aside 12K of memory, then using it in combination with some machine language subroutines, to maintain a video buffer and several animation images. First, the Poly software is told to move all video operations to the video buffer, instead of an actual video screen. Consequently, all printing and plotting will be done into this area of RAM. The BASIC program then selects an appropriate image, from the animation memory, and uses a CALL function to invoke a machine language subroutine. This routine copies this image into the video buffer. The buffered image then has the variable elements added to it by BASIC, using print and plot statements. Finally, the composite buffered image is moved to the appropriate video screen by one of three CALL functions.

The CALL function which moves the video buffer to the main screen, is a call to the subroutine NUSCRN. This subroutine enables the video service routine to do the transfer using the next eight real time clock interrupts. The other two CALL functions are used to transfer the video buffer to the smaller port and starboard screens, which are not linked into the real time clock service routines. Instead, they are simple Z-80 block move instructions which transfer all 1024 bytes as one operation.

Rather than explaining the assembly listing to illustrate the video animation, we will examine the various

CALL functions which are used by BASIC to compose the video images. All addresses in these CALL functions are expressed as decimal addresses for the convenience of BASIC.

X = CALL (1024,N) subroutine "START"	Enables the video service routine to display the 1K of memory starting at N on the main video screen, using continuous refresh.
X = CALL (1099) subroutine "STOP"	Disables the video service routine.
X = CALL (1106,N) subroutine "ONCE"	Enables the video service routine to display the 1K of memory starting at N on the main video screen, without refresh.
X = CALL (1120) subroutine "NUSCRN"	Enables the video service routine to display the video buffer without refresh.
X = CALL (1127,N) subroutine "MOVPIX"	Moves the ½K of memory starting at N to the top half of the video buffer.
X = CALL (1137) subroutine "MOVFRM"	Moves the ½K of memory starting at 47616 to the bottom half of the video buffer.
X = CALL (1376) subroutine "NUSCRN2"	Moves the entire video buffer to the starboard screen.
X = CALL (1388) subroutine "NUSCRN3"	Moves the entire video buffer to the port screen.
X = CALL (1400,N) subroutine "LDBFR"	Moves the 1K of memory starting at N to the video buffer.

## BASIC INTERFACES

We have just seen how the CALL function has allowed a BASIC program to manipulate three video screens. Other functions of the simulation are handled through the PEEK, POKE and OUT statements. For example, when the BASIC program needs to know the value of a particular control, or switch, the PEEK function is used to read the contents of the memory byte dedicated as the communications link for that control or switch. When the speakers are to be used, BASIC uses OUT statement to control the counter timer channels for each speaker with the appropriate control codes. The POKE statement is used in a fashion similar to the PEEK function when the telltale lights are to be accessed, since the control of the port for the lights is in the real time clock interrupt service routine.

## CONCLUSION

The design and construction of the SFS Walletsize was intended to be a low cost approach to real world control systems, with a particular emphasis on real time operation and analog I/O, using a composite of BASIC and machine language. In addition, this project has served as a test bed for some new and different ideas, in both hardware and software, without the pressure that would be inherent in a more serious application.

As it stands, there are several errors in the software, which are known to the authors, and possibly several more which have yet to be discovered. These known errors affect the behavior of the controls in a predictable way and it is sometimes necessary to program around them. Despite these errors, it was possible to achieve a very fine degree of control over the simulated craft. □



Figure 9. Listing of service routine.

0000	START	PUSH D	0570	DW 0B0EDH LDIR
0010		DW 0E1DDH POP IX	0580	RET
0020		LXI H,0	0600	CNTRL5 IN 0AH
0030		SHLD BLOCK	0610	STA PORTA
0040		MVI A,0	0620	IN 08H
0050		STA FLAG	0630	STA PORT8
0060		LXI H,RETSRV	0640	CNTRL1 LXI H,CMEM
0070		SHLD 0035H	0650	IN 36H
0080		RET	0660	ADD M
0090	FLAG	DB 00	0670	RAR
0100	BLOCK	DW 0000	0680	MOV M,A
0110	RETSRV	IN 0AH	0690	INX H
0120		STA PORTA	0700	IN 37H
0130		IN 08H	0710	ADD M
0140		STA PORT8	0720	RAR
0150		LXI H,0F000H	0730	MOV M,A
0160		DW 04BEDH LD BC	0740	INX H
0170		DW BLOCK	0750	IN 33H
0180		PUSH B	0760	ADD M
0190		DAD B	0770	RAR
0200		XCHG	0780	MOV M,A
0210		DW 0E5DDH PUSH IX	0790	INX H
0220		POP H	0800	IN 3BH
0230		DAD B	0810	ADD M
0240		LXI B,0080H	0820	RAR
0250		PUSH B	0830	MOV M,A
0260		DW 0B0EDH LDIR	0840	INX H
0270		POP B	0850	IN 3EH
0280		POP H	0860	ADD M
0290		DAD B	0870	RAR
0300		MOV A,H	0880	MOV M,A
0310		CPI 04	0890	INX H
0320		JNZ SKIP	0900	IN 3FH
0330		LXI H,0	0910	ADD M
0340		STA FLAG	0920	RAR
0350	SKIP	SHLD BLOCK	0930	MOV M,A
0360		JMP CNTRL1	0940	INX H
0370	STOP	LXI H,CNTRL5	0950	MVI A,43H
0380		SHLD 0035H	0960	OUT 36H
0390		RET	0970	OUT 37H
0400	ONCE	CALL START	0980	OUT 33H
0410	TEST	LDA FLAG	0990	OUT 3BH
0420		DRA A	1000	OUT 3EH
0430		JZ TEST	1010	OUT 3FH
0440		CALL STOP	1020	MVI A,45H
0450		RET	1030	OUT 36H
0460	NUSCRN	LXI D,0BC00H	1040	OUT 37H
0470		CALL ONCE	1050	OUT 33H
0480		RET	1060	OUT 3BH
0490	MOVPIX	LXI H,0BC00H	1070	OUT 3EH
0500		XCHG	1080	OUT 3FH
0510		LXI B,0200H	1090	MVI A,0FFH
0520		DW 0B0EDH LDIR	1100	OUT 36H
0530		RET	1110	OUT 37H
0540	MOVFRM	LXI H,0BA00H	1120	OUT 33H
0550		LXI D,0BE00H	1130	OUT 3BH
0560		LXI B,0200H	1140	OUT 3EH
			1150	OUT 3FH



1160	LDA LTPORT	1740	DW 10CBH
1170	OUT 08H	1750	ADC M
1180	LDA 0C00H	1760	MOV M,A
1190	ANI 0FH	1770	INX H
1200	JNZ 0042H	1780	XRA A
1210	LDA PORTA	1790	DW 10CBH
1220	MOV B,A	1800	ADC M
1230	XRA A	1810	MOV M,A
1240	DW 10CBH RLB	1820	INX H
1250	SBI 0	1830	XRA A
1260	ORA M	1840	DW 10CBH
1270	MOV M,A	1850	ADC M
1280	INX H	1860	MOV M,A
1290	XRA A	1870	INX H
1300	DW 10CHB RLB	1880	XRA A
1310	SBI 0	1890	DW 10CBH
1320	ORA M	1900	ADC M
1330	MOV M,A	1910	MOV M,A
1340	INX H	1920	INX H
1350	XRA A	1930	XRA A
1360	DW 10CBH	1940	DW 10CBH
1370	SBI 0	1950	ADC M
1380	ORA M	1960	MOV M,A
1390	MOV M,A	1970	INX H
1400	INX H	1980	XRA A
1410	XRA A	1990	DW 10CBH
1420	DW 10CBH	2000	ADC M
1430	SBI 0	2010	MOV M,A
1440	ORA M	2020	INX H
1450	MOV M,A	2030	XRA A
1460	INX H	2040	DW 10CBH
1470	XRA A	2050	ADC M
1480	DW 10CBH	2060	MOV M,A
1490	SBI 0	2070	INX H
1500	ORA M	2080	XRA A
1510	MOV M,A	2090	DW 10CBH
1520	INX H	2100	ADC M
1530	XRA A	2110	MOV M,A
1540	DW 10CBH	2120	JMP 0042H
1550	SBI 0	2130	NUSCRN2 LXIH BC00H
1560	ORA M	2140	LXID F400H
1570	MOV M,A	2150	LXIB 0400H
1580	INX H	2160	LDIR
1590	XRA A	2170	RET
1600	DW 10CBH	2180	NUSCRN3 LXIH BC00H
1610	SBI 0	2190	LXID F800H
1620	ORA M	2200	LXIB 0400H
1630	MOV M,A	2210	LDIR
1640	INX H	2220	RET
1650	XRA A	2230	LDBFR LXIH BC00H
1660	DW 10CBH	2240	XCHG
1670	SBI 0	2250	LXIB 0400H
1680	ORA M	2260	LDIR
1690	MOV M,A	2270	RET
1700	INX H	2280	PORTA EQU 0D00H
1710	LDA PORT8	2290	PORT8 EQU 0D01H
1720	MOV B,A	2300	LTPORT EQU 0D02H
1730	XRA A	2400	CMEM EQU 0D03H






# FLOPPY ROM<sup>TM</sup> LOADING TECHNIQUES, PART 1

By Orv Balcom





*The Floppy ROM\*, is probably one of the better methods of information interchange to come along. However, like any new concept it has presented some problems for many potential users. Therefore, to insure the viability of the Floppy ROM, as an applications media, we contacted Orv Balcom, of Brown Dog Engineering, to write a two part series on Floppy ROM loading techniques.*

*Part I deals mainly with hardware considerations, and what the correct signals should look like. Part II will cover the software needed to recover from a read error.*

*Hopefully, this series of articles will answer the many questions we have had over the past several months. Any further questions that you may have can be directed to either Orv or INTERFACE AGE.* —Editor

## THE FIRST TIME

Hobby computers are great fun. The ultimate crossword puzzle. The chess game you never quite win. However, a computer is just a toy without software. So it was with great enthusiasm that I took the Floppy ROM™ from the May 1977 INTERFACE AGE and headed for the stereo. At last, low cost easily distributed programs. It didn't matter that I had an 8080 system and the ROM was for a 6800 CPU. It was the concept.

I put it on good 'n loud and sat down to finish reading INTERFACE AGE. I was sitting there grooving on BASIC, in Kansas City Quadrophonic, when my partner and the dog returned from shopping. I then realized their lack of appreciation for good "computer sounds" as they took a vote, I lost 2 to 1, and replaced the ROM with Jackson Browne. I followed the progress of the Floppy project and when the October issue came, complete with a General Ledger program in MITS BASIC, I was ecstatic. It was unimportant that I didn't have a disk or a line printer, or that the program was in Disk BASIC and I only had 4.0 Extended. It was for an 8080 with a Tarbell cassette interface. It would be a great starting place for a real application program. Back to the stereo to dub off a copy on my cassette recorder. I even put the Dolby switch on to get some high frequency pre-emphasis. Then off to the computer lab to load up BASIC and try a real application program.

I typed a CLOAD"A" and crossed my fingers. Got an OK then typed LIST and there it was, the Floppy ROM and Bud Shamburger in action. Everything was fine until near the end of the listing there were some funny characters, which I assumed were Disk BASIC tokens that my BASIC couldn't translate. I was getting a little cocky, so I tried program "D." Nothing! The computer didn't even see the sync byte, so nothing happened. BASIC just hung. Tackling the problem with a little more realism, I went through the whole cassette, reading what I could into the computer and recording it back off as a

\*Floppy ROM is a registered trademark of INTERFACE AGE Magazine, Cerritos, CA.

normal Tarbell cassette. In general, it was only possible to recover about 30% of the code, which was not too exciting. Well, put it back on the shelf and wait for the next two copies of INTERFACE AGE and the program source. It wasn't as easy as "lifting the tone arm and recording."

The Floppy ROM didn't come up on the que until Christmas, when Santa was nice enough to drop off a couple of floppy disk drives and a Tarbell disk interface. Now I had a real reason for trying to read the Floppy ROM. Back to the stereo, but this time with a "plan."

## EQUIPMENT

One's success in loading a MITS BASIC-Tarbell Floppy ROM will depend to a large extent on the equipment used. As a minimum, the following are necessary to load the General Ledger programs: An 8080 or Z-80 computer, a Tarbell cassette interface, MITS 4.0, or newer, Disk or Extended BASIC patched for the Tarbell cassette, at least 20K of RAM greater than the size of your BASIC.

Some comments on these requirements are in order. If you have a Z-80 system, be sure your MITS BASIC has been modified to run with the Z-80. Some won't without changes. Also, your Tarbell interface must be working right. You should be able to load object tapes, not just BASIC programs, consistently without errors. At least ten 16K tapes in a row error free. If not, fix the interface-recorder combination first. Loading the Floppy ROM taxes the capabilities of the system, and it's no use burdening the project with bad equipment.

There is no such thing as standard Tarbell-MITS BASIC. MITS BASIC supports the MITS cassette interface only. Don Tarbell has included patches for all known versions in his cassette manual and it can be assumed that if you have a Tarbell-MITS BASIC, it conforms to these modifications. If you have unexplained problems, check your BASIC against the patches in the Tarbell manual. MITS BASIC condenses all reserved words into 1-byte tokens before recording. Also, line start addresses are imbedded in the code and line numbers are in HEX when recorder. Unless your BASIC conforms to these conventions, you won't be able to List it after you load it. MICROSOFT's BASIC should work, since they wrote the BASIC for MITS, but the CP/M version I've seen doesn't have a cassette load command. Older versions of MITS BASIC, as well as their 8K version, use different tokens and won't List correctly. As for the last requirement, if GL2 is 20.5K bytes long, you need enough memory past BASIC to store it.

The audio equipment required to read the ROM consists of a good changer or turntable, a pre-amplifier and a cassette recorder. The changer preferably should be of good quality and have an adjustable tone arm tracking force. My own changer is a Dual 1228 with an Audiotechnica AT12S cartridge. For reading the Floppy ROM, I have found that about 2½ grams of stylus pressure seemed to track the best. Remember, the higher the pressure, the more record wear. If you try to run too



light, the arm may tend to not track the data correctly, but if it's too heavy, the cartridge may bottom out. As I mentioned above, I originally tried to record the ROM directly on my good cassette recorder with less than optimum results. This time I used the cassette recorder which I normally use with my Tarbell interface, which is a J.C. Penney's Model 6536.

The signal phasing through your audio system must also be considered. There are some industry standards for phasing, but unless your equipment is connected per these standards, there is no guarantee that the phase of the signal applied to your recorder will be the same as when it was recorded on the Floppy ROM. The effect of this problem is that the phase switch, Switch 7 on the Tarbell board, may have to be reversed to read tapes that you have generated from the Floppy ROM.

### CASSETTE FORMATS

I have mentioned a couple of types of cassette formats: Kansas City Standard and the Tarbell format. These should be examined with a little more depth. The Kansas City Standard defines a format for asynchronous transmission of data using a frequency modulated carrier. It is similar to punching data on a paper tape. Each byte is serially transmitted as 8 separate bits preceded by a start bit and followed by 2 stop bits. A 1 bit is signified as a 2400 Hz signal and a 0 bit is a 1200 Hz signal. Eight cycles of the carrier are used at 2400 Hz and 4 cycles at 1200 Hz so the bit timing will remain constant. The Tarbell cassette interface, on the other hand, is a synchronous form of transmission. In other words, all the data is synchronized to a clock signal. The clock is 1500 Hz and is implied in the format but is not actually recorded on the tape. The signal on the tape is the clock signal with the phase reversed every time the bit pattern changes from 1 to 0 or 0 to 1. Phasing is such that a 0 is signified when the signal on the tape is in phase with the implied clock.

There is a third tape format to consider, which is the one supported by MITS. Their format is similar to the Kansas City format except the carrier frequencies used are 1850 Hz and 2400 Hz which originated from Bell Telephone standards. This is the format MITS BASIC originally used.

There is an obvious difference between these three methods of recording. The Kansas City format takes 8 or 4 cycles of the carrier frequency to signify 1 bit and runs at 300 baud. The MITS interface also records at 300 baud. On the other hand, the Tarbell defines one bit for each cycle of the clock frequency. With the standard clock frequency of 1500 Hz, the Tarbell data recording rate is 187 bytes/second as compared to about 30 bytes/second with the other methods.

The standards discussed only define the form of data recording at the byte level. They do not consider the way in which the bytes are arranged on the tape. Are they recorded as straight memory image or blocked into smaller sections with headers and trailers? Is there any form of error detection contained on the tape? The format of the tape is generally specified by the using software. In the semi-standard marriage of MITS BASIC and the Tarbell interface, the actual program is preceded by the name, the A in CLOAD "A", so that a program can be located on a tape but no form of error detection is used. What this means, is that you must specify the correct program name when loading the program. Also, after you load your cassette into MITS BASIC there is really no way to tell if you had a valid load other than Listing the program. Generally, if you can list the last line, there are no major errors.

### FLOPPY ROM FORMAT

With the preceding in mind, one may question why

the Tarbell format would be used on a Floppy ROM. If you lose one bit of data, the remainder of the program can be out of sync and possibly unrecoverable. The real advantage of the Tarbell system is that it loads data approximately 6 times faster than the Kansas City Standard. The Kansas City Standard is running at approximately 30 characters per second, while the Tarbell runs at 187 characters per second. The General Ledger program, on the Floppy ROM, had a total of over 76,000 bytes. This means 8 minutes of recording using the Tarbell format, but would be around 43 minutes of recording using the Kansas City format. This is about the time available on a 12-inch LP. It is too much to put on a Floppy ROM that will fit in INTERFACE AGE. So, it boils down to this, if a lot of data is to be transmitted on one Floppy ROM, it has to be recorded at a rate higher than 300 baud.

The next question is, if we are stuck with synchronous transmission, what is the best way to get this data from the record and into the computer? Let's consider first the problem of getting the signal off the Floppy ROM. It should be noted that the ROM is recorded as a monaural record. I am sure most of us have stereo equipment. Especially if we consider the best piece of audio equipment we have access to, it is certainly stereo. Monaural signals are recorded on a disk by moving the recording tool laterally. Stereo signals, on the other hand, are recorded by moving the cutting tool in both the lateral and vertical directions. The actual signal for either the right or left channel is recorded at 45 degrees to vertical. The lateral movement of the record groove is the monaural component of the signal and the vertical movement is the stereo component of the signal. This was done so that monaural equipment could play stereo records and vice versa. For recovering the digital information on a Floppy ROM, we are only interested in the lateral movement. Many stereo receivers contain a switch which will allow converting from stereo to monaural. In the case of my own unit, this conversion is allowed only on FM receptions and not for phonograph records. The effect of this stereo/monaural problem is that much of the noise and rumble of a turntable is in the vertical mode. It would be best that we did not sense this. A true monaural cartridge would be an advantage at this point, but there are ways to improve the signal-to-noise ratio, even with a stereo cartridge, which will be explained later.

### READING THE FLOPPY ROM

With all that theory behind us, let's try to read the Floppy ROM. Satisfactory operation of the Tarbell cassette interface board is, to a large extent, dependent on the wave form from the cassette recorder. The input stage of the board looks at zero crossings of the audio signal to regenerate the digital signal. It is imperative that the board detect a zero crossing only when there is a zero crossing in the input data. An extra zero crossing, or a missing one, will scramble the output code and make the remainder of the record invalid.

Photo 1 is the recorder output, interface input, of a tape made by the computer and the Tarbell interface. If the signal recovered from the Floppy ROM will look like this, the interface should be able to read it. There are two separate problems: First, the waveform to the computer should approximate Photo 1, with no extra zero crossings. And second, there can be no extraneous noise signals that alter the waveform to produce or delete zero crossings. Photo 2 shows the output signal from the sync byte track of the Floppy ROM for the right channel. This output was obtained at the tape recorder output jack of my receiver. Photo 3 shows the same thing, but with the time base slowed down to approximately 1 second for the full display. You may note a certain uneven-



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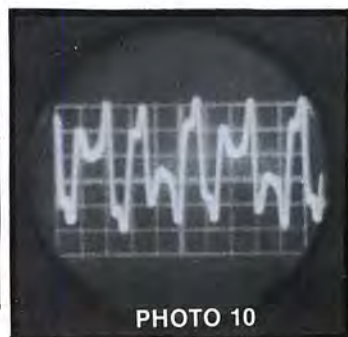
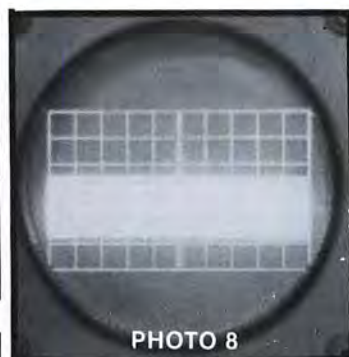
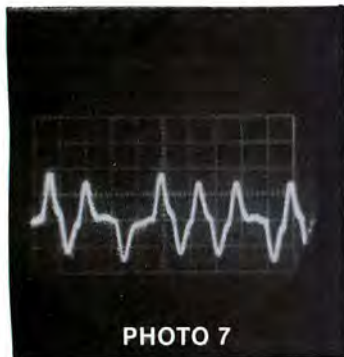
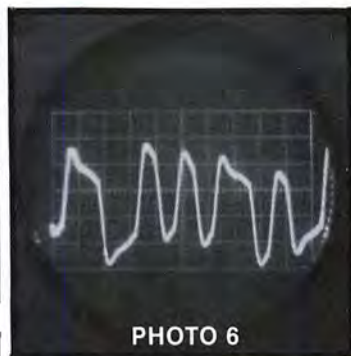
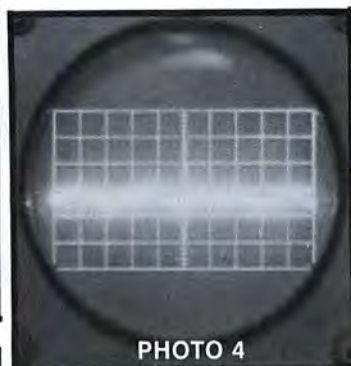
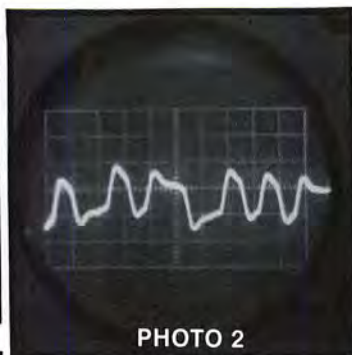
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ness in the carrier envelope. This is one of the problems in reading the Floppy ROM. Photo 4 shows the base line with the needle just sitting on the track between sections of code on the Floppy ROM. Note the waviness in it. This is a low frequency effect caused by vertical movement of the record. Photo 5 shows a worse culprit, a scratch that I had in my copy of the ROM. In this photo, the time base is running at 5 milliseconds for a full screen, which is similar to that for observing a normal waveform. It is obvious that if a pop like this occurs during the code transmission, it can give erroneous results.

Photo 6 is the waveform that I obtained from the sync byte portion of the Floppy ROM, but with the output obtained from the speaker terminals of my receiver. Compare it with Photo 2. Note the additional deviation in the peaks of the waveform. This is due to the bass boost from the "loudness" compensation in the receiver. The preamplifier (up to the tape output) has fixed frequency response which corresponds to the NAB equalization requirements. But from there to the speaker, there is the loudness compensation and the tone controls. The tone controls are not in effect unless you take the output from the speaker terminals. This is probably true of most receivers. Photo 7 shows the effect of cutting the bass all the way to 0 and adding some treble boost. The waveform at this point is very similar to that which is obtained out of the cassette recorder (Photo 1), when playing computer generated tapes. It should be remembered that this will become the input to the cassette recorder. The normal input to the cassette recorder is a digital square wave generated by TTL logic, so we can see that there may possibly be some problem already.

Looking back at Photos 3 and 4, it can be seen that there is a wandering of the baseline caused by the vertical outputs from the record. Since the Tarbell system looks at zero crossings, this could, if it were bad enough, move a signal up so that a zero crossing would be missed. The additional low frequency response, in Photo 6, accentuates this problem. Also, when reading off just one side of the stereo circuitry, we are losing 3dB of the information since the power in any one channel is 3dB less than the total power in a monaural record. If you don't have a monaural switch for your phono input, you can build the summing circuit shown in Figure 1. This will give an additional 3dB of signal-to-noise ratio and also remove the low frequency components of the recovered signal.

The Tarbell interface does not require any low frequency components. Instead, what it likes is a linear phase relationship in the low frequency area. As long as the waveform does not dip below the center line on recovery, the interface doesn't really care what happens with frequencies under  $\frac{1}{2}$  the clock rate. The circuit of Figure 1 also adds high frequency emphasis to try to make up for the recorder input not being a square wave. Since by this time the signal was too low to go into the auxiliary input of my cassette recorder, I reduced it another 10:1 and fed it into the microphone input.

Photo 8 shows a slow scan of the sync stream waveform, using this circuit. Notice that there is essentially no modulation of the carrier. Photo 9 shows the waveform and it should be noted that it is very similar to Photo 1. All that is now necessary is for the cassette unit to record and reproduce this signal without alteration. Since there are less stages to introduce phase shift and since the frequency response modification is fixed, this seemed like a better approach than using the whole receiver circuit. When operating from the speaker terminals, the loudness compensation, tone controls, and the volume setting can all affect the reproducibility of the signal. It should be noted that there is a fair amount of high frequency pre-emphasis added at this point. When



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reading the tape into the computer, the tone control should now be set for flat response instead of maximum high frequency emphasis, as suggested by Don Tarbell. Photo 10 is the waveform from the cassette recorder when playing a tape, recoded as described above, with the tone control left at maximum. Note the dips in the waveform caused by the overcompensation. This can not be read properly by the Tarbell interface. Changing the tone setting should only be done when reading this cassette into the computer for the first time. All subsequent reads and writes should use the normal tone control settings.

### LOADING THE FLOPPY ROM

With the above information in mind, how does one load a Tarbell-formatted Floppy ROM? Of course, one can just record the cassette off, bring up BASIC and try to load it. That didn't work for me. A more systematic approach is as follows: First, record, using the method described above, two or three repeats of the sync stream. Now, take this to your computer and remove the cover so that you can see the LED on the Tarbell board. Do not readjust the potentiometer on the Tarbell board. Keep it at its normal setting. Attempt to play back a sync stream and vary the volume and tone controls on the cassette recorder until you get the LED to light continuously. The volume control should be at approximately the same place as normal recording, but the tone control will be reduced to somewhere near mid range. The proper settings are where movement of either the tone control or the volume control will not change the steadiness of the sync stream detector LED. If you cannot get the sync stream detector to come on at all, try switching the phase switch on the Tarbell interface.

As mentioned previously, there is no guarantee that the phasing of your record changer and receiver is correct. It very well may be inverted. This is not a problem since you only need to change the switch while you are reading in these tapes for the first time. Rearrange the boards in your computer so that you can set this switch without shutting down the computer, because you are going to want to record off the data in your normal fashion later.

Another way to do this, if it is convenient to get your changer/receiver near your computer, would be to feed directly out of your receiver into your computer. You need around 3-4 volts peak-to-peak, over 1 volt rms, to the Tarbell interface to make this work. Also, your audio equipment must be transformer isolated, but if it has a tape monitor output, it most surely is. This approach does have the advantage of not having the second step of going through the cassette. If this approach is tried, either use the summing circuit shown in Figure 1, or take the signal from the speaker terminals and turn the

treble control all the way up and the bass control all the way off. The cassette interface would like to see a signal with a lot of high frequency emphasis and very little bass.

By this time, the sync LED should stay on in a smooth manner throughout the sync tape. Now, repeat the same process, but record one of the shorter tracks, like say, the first track COPCON. Bring up BASIC and load this with a `CLOAD "A"`. At the end of the tape, BASIC should say OK. This does not mean it was a good load since there is no error checking with BASIC tapes. If it was an extremely bad load, BASIC may hang. Your keyboard won't work — nothing will work. If this happens, you must restart, and possibly reload BASIC.

Now try to List the program. You should at least be able to list the title and program description which are in ASCII. If you do not have the proper Altair Disk BASIC, but are instead trying to load it into Extended BASIC, which is possible, at least to check how you are doing, you will get some strange symbols. If you are not able to totally list the program, move the tone control a little bit and try again. You shouldn't have to change the volume control since it should be pretty near your normal setting. After you get it to load, correct the phase switch, if you had to change it initially, and record off at least two copies using your normal recording procedure. This is very important because the copies you record back from your computer will be much more reliable than the one you took off the Floppy ROM. This is because you will be running the standard TTL square wave inputs to your cassette recorder.

In my own situation, if I get a bad read, I run into some extra problems because my video display driver uses control characters as cursor controls. Control L also sets the unit into the graphics mode. If I'm reading a bad tape, somewhere along the line a control character will cause very unpredictable results to my display. Be sure that you do not have anything running, such as your disk drive, while reading or Listing tapes for the first time. MITS BASIC can do some strange things if it gets a bad tape, like writing garbage file to your disk!

I have been able to load successfully nearly all the code of the General Ledger Floppy ROM. Naturally, the harder ones are the programs GL-2 and GL-7 because of their length. As was mentioned previously, a single glitch in a record can throw the remainder of the record off. This is a problem inherent with the synchronous method of transmission and is one of the trade-offs that are made. But on the other hand, loading 20,000 bytes in two minutes can't be free. □

*Orv can be contacted by writing to: Orv Balcom, Brown Dog Engineering, P.O. Box 427, Lomita, CA 90717.*

*—Editor*

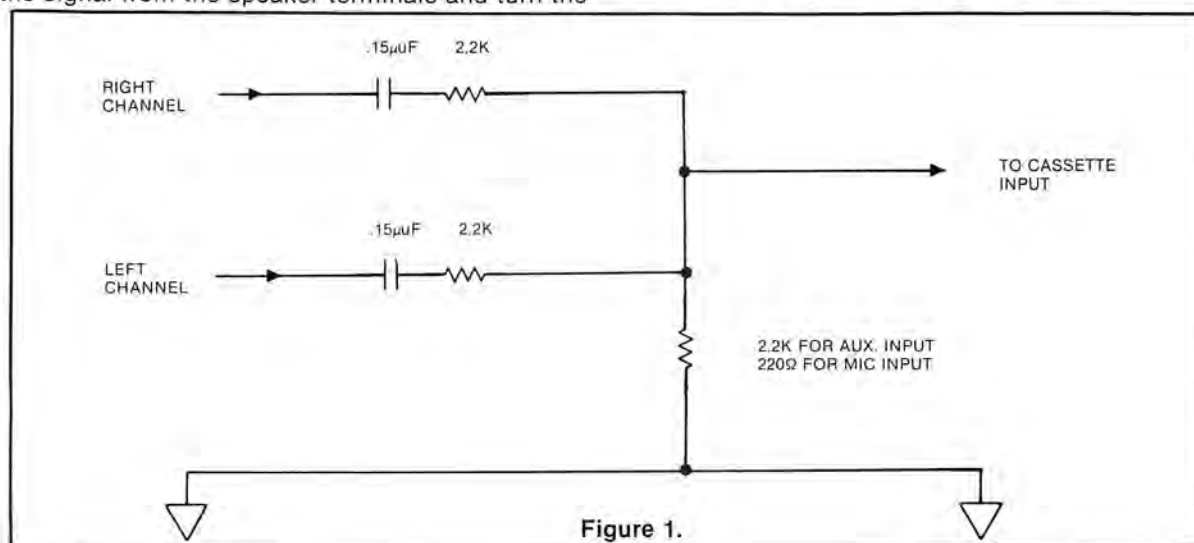


Figure 1.



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## SESSION MENU

### MARCH 17, 1978

Adam Osborne, Osborne & Associates, Inc. — 10:00 a.m.-1:00 p.m.  
"Small Business Computer Systems; An Analysis of Products and Markets"

*Opposite*

Pete Roberts, Computer Kits — 10:00 a.m.-1:00 p.m.  
"The Role of Computer Stores in Small Business Systems"

LUNCH 1:00-2:00 p.m.

Thomas Bun, CompuMax Associates — 2:00 p.m.-5:00 p.m.  
"The Entry of Calculator Manufacturers into the Small Business Systems Market"

*Opposite*

Gerry Cullen, Datapoint Corporation — 2:00 p.m.-5:00 p.m.  
"The Established Small Business Computer Manufacturers"

### MARCH 18, 1978

Matt Peterson, Peterson & Associates, Inc. — 9:00 a.m.-12:00 Noon  
"The Role of Established System Software Companies in the New Small Business Systems Market"

*Opposite*

John Peers, Logical Machine Corporation — 9:00 a.m.-12:00 Noon  
"Looking at the Future of Business Computer Systems"

LUNCH 12:00 Noon-2:00 p.m.

Gene Murrow, Computer Power & Light — 2:00 p.m.-5:00 p.m.  
"Some Small Business Computer Users; Their Experience as Customers"

*Opposite*

Robert C. Brehm, Promedics Data Corporation — 2:00 p.m.-5:00 p.m.  
"Microcomputer-Based Business Systems in the Medical and Legal Professions"

### MARCH 19, 1978

Lon Poole, Osborne & Associates, Inc. — 9:00 a.m.-12:00 Noon  
"Practical Low-Cost Software for Microcomputers"

*Opposite*

Michael Levy, Jethro — 9:00 a.m.-12:00 Noon  
"Systems Analysis for Small Business"

LUNCH 12:00 Noon-1:00 p.m.

Gordon French, Commodore Business Systems — 1:00 p.m.-4:00 p.m.  
"The Form for Small Business Software Packages"

*Opposite*

Harold Williams, Radio Shack — 1:00 p.m.-2:00 p.m.  
"The Entry of Retail Mass Merchandising into Small Business Systems"



**SESSION #1**

Title:

"Small Business Computer Systems; An Analysis of Products and Markets" — 10:00 a.m.-1:00 p.m.

... In order to provide perspective papers in this session we will examine the history of small business systems, the entry of microcomputers into this marketplace and their future potential. Papers will stress problems and mistakes that have been made as well as achievements and hopes for the future.

Chairman: Adam Osborne  
Osborne & Associates, Inc.  
630 Bancroft Way, Berkeley, CA 94710

Panelists:

Jim Warren, Editor of Dr. Dobb's Journal  
... This presentation will concentrate on these new applications of consumer computers and a variety of probable business applications related to them.

Howard Sidorsky, President, Phase One  
... This paper will present a perspective of microcomputers in business applications, as seen by someone who has a long history of selling small computers into business applications.

Dick Heizer, Computer Store  
... This paper will outline the business applications that are currently available, as against applications which will become available in the future.

**SESSION #2**

Title:

"The Entry of Retail Mass Merchandising Into Small Business Systems" — 1:00 p.m.-2:00 p.m.

... This session will discuss commercial computer marketing with all its pitfalls and successes.

Chairman: Harold Williams  
Radio Shack  
2617 7th Street, Fort Worth, TX 76107

Panelists:

Mr. Williams' speakers will be announced at the conference.

**SESSION #3**

Title:

"The Role of Computer Stores in Small Business Systems" — 10:00 a.m.-1:00 p.m.

Chairman: Peter Roberts  
Computer Kits  
1044 University Avenue, Berkeley, CA 94710

Panelists:

Mr. Roberts' speakers will be announced at the conference.

**SESSION #4**

Title:

"The Entry of Calculator Manufacturers into the Small Business Systems Market" — 2:00 p.m.-5:00 p.m.

... Since the late sixties, as the leading calculator manufacturers started to gradually increase the capabilities of their products, the outlines of the "Computer/Calculator Boundary Problem" began to take shape. With the emergence of built-in special functions and programmability, the question arose: "Where does a calculator end and a computer begin?"

Chairman: Thomas P. Bun

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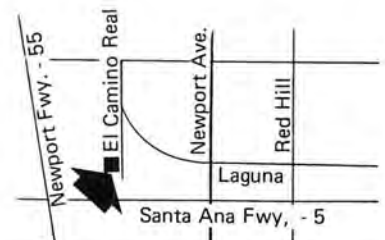
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**Panelists:**

Chuck Peddle, Manager of PET System Division at  
Commodore Business Machines

... As the microcomputer market is taking shape, application software is ever more important. Specialized procedures have to be designed to meet the requirements of this market in time.

Alex Sozonoff, Marketing Manager of Fort Collins Division at Hewlett-Packard Company

... Programmable calculators led the way to specialized small systems. As the thrust moves toward business applications, major differences require new approaches.

Dr. David Chung, Vice-President of Umtech, Inc.

... Since the average consumer does not want to write his own programs, there is a well-defined need for turn-key systems. Innovative approaches are required to set up the development of these systems and in particular of their application software.

## SESSION #5

**Title:**

"The Established Small Business Computer Manufacturers" — 2:00 p.m.-5:00 p.m.

... One of the most important points for the businessman to consider about computer manufacturers is: growth paths. Is there full upward and downward compatibility and modularity in the computer product line? When the business grows, can the computer grow with it, or must one scrap the initial investment and start over? What kind of minimum investment is required in order to get the benefits of computing?

**Chairman:** Gerry Cullen

Datapoint Corporation  
9725 Datapoint Drive, San Antonio, TX 78284

**Panelists:**

Sylvia Twomey, Director of Advanced Systems Planning for Tigor Mortgage Insurance Company

... As director of Advanced Systems Planning for Tigor Mortgage Insurance Company, Ms. Twomey uses a nationwide network of minicomputers to input, edit, and report on mortgage insurance policies and to transmit data nightly to a centralized mega-mini for batch processing. This paper describes Ms. Twomey's experiences.

Richard Foster, Telos Computer, Inc., in Santa Monica

... This paper discusses the role of the software vendor in supporting the initial entry of a small business user into the world of computing. The paper will emphasize the benefits of planning for the implementation of computerized business systems.

## SESSION #6

**Title:**

"The Role of the Established System Software Companies in the New Small Business Systems Market" — 9:00 a.m.-12:00 Noon

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**Chairman:** Matt Peterson

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**Panelists:**

Doug Hughes, Cincom of Cincinnati, Ohio

... This presentation will provide an indepth look at the functions and facilities of minicomputer hardware and software, and will discuss several applications of data base technology on minicomputers.

Don Seiberg, Cincom of Cincinnati, Ohio

... This session will discuss present levels of product capabilities for mid and large scale minicomputers. This presentation will also cover the trends which are presently taking place that will shape future product development.

## SESSION #7

**Title:**

"Looking at the Future of Business Computer Systems" — 9:00 a.m.-12:00 Noon

**Chairman:** John Peers

Logical Machine Corporation  
1294 Hammerwood Avenue, Sunnyvale, CA 94086

**Panelists:**

A. Terrence Easton, President of International Communication Management and Director of MBA Program and Telecommunications at Golden Gate University

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Additional panelists will be announced at the conference.

## SESSION #8

**Title:**

"Some Small Business Computer Users; Their Experience as Customers" — 2:00 p.m.-5:00 p.m.

... Everyone has read and heard the "hype" about microcomputers in small business, but what do the people who are using them and depending on them have to say?

**Chairman:** Gene Murrow

Computer Power & Light, Inc.  
12321 Ventura Boulevard, Studio City, CA 91604

**Panelists:**

John Ondrasik, President of Precision Wire Products

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Tom Lambert, ESQ., of Tom Lambert, ESQ., & Associates

... Mr. Lambert uses his computer for word processing and mathematical analyses of aircraft components.

Sheldon Allman, of Sheldon Allman & Associates

... Mr. Allman offers clients and prospective investors in income properties computer prepared forecasts of cash flow and return on investment.

Prof. Audrey Roche, an independent accountant and Professor

... Ms. Roche uses general ledger programs to keep books for many of her clients, also using it as a basis for teaching a class in computer-based accounting methods.

## SESSION #9

**Title:**

"Microcomputer-Based Business Systems in the



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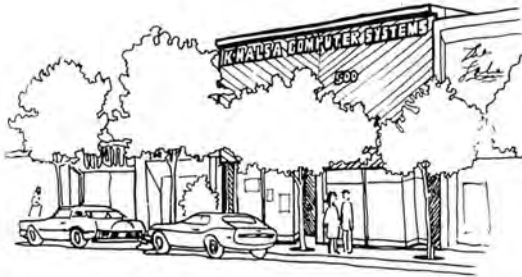
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Medical and Legal Professions" — 2:00 p.m.-5:00 p.m.

... This session will discuss medical and dental office management systems using microcomputers.

Chairman: Robert C. Brehm  
Promedics Data Corporation  
560 San Antonio Road, Suite 201A, Palo Alto, CA 94306

**Panelists:**

Jim Fencil, Cypress Computer Corporation  
... This paper will discuss elimination of paperwork in the office using a computer system.

Jim Berchtold, President, Computer Consulting Services  
... This paper will describe use of a Commodore PET system to diagnose and evaluate respiratory ailments in patients.

Steve Rothenberg, President, Rothenberg Information Systems  
... This paper discusses word processing in legal and professional offices.

**SESSION #10**

**Title:**

"Practical Low-Cost Software for Microcomputers"  
— 9:00 a.m.-12:00 Noon

... This session will explore one inexpensive way to program your microcomputer — published software. Published software means computer programs you can obtain free or at low cost from books, magazines, etc. We will discuss what kinds of programs are being published, what has gone into making them, and what you can expect to have once you get them.

Chairman: Lon Poole  
Osborne & Associates, Inc.  
630 Bancroft Way, Berkeley, CA 94710

**Panelists:**

Dr. Adam Osborne, publisher of a series of books of programs and president of Osborne & Associates, Inc.  
... Osborne & Associates are supplying the microcomputer industry with low-cost applications software by publishing software in the form of books. This paper discusses the strategy and objectives of this endeavor.

Jim Schreier, President of The Schreier Software Index  
... Mr. Schreier will describe the events leading to the publication of the Schreier Software Index. He will also dis-

cuss the kinds of published software currently available.

Carl Warren, Senior Editor, *INTERFACE AGE* Magazine, and Author of *From The Counter to the Bottom Line*  
... Mr. Warren will discuss how a small businessman might go about using published software to do his accounting.

Scott Brim, President of Computer Systems for Business, Inc.

... Mr. Brim will discuss converting *Payroll With Cost Accounting* to the Alpha Micro System.

**SESSION #11**

**Title:**

"Systems Analysis for Small Business"  
— 9:00 a.m.-12:00 Noon

... We will discuss the nature of small business markets and entrepreneurs, of computer people, and the usual difference in their respective approaches. We will cover survey techniques, and some simple documentation and planning methods.

Chairman: Michael Levy  
Jethro  
70 Boston Post Road, Wayland, MA 04306

**Panelists:**

Panel members will be announced at the conference.

**SESSION #12**

**Title:**

"The Form of Small Business Software Packages"  
— 1:00 p.m.-4:00 p.m.

... How will it be possible to vend software packages to the computer illiterate businessman? Who will assist him in implementing his system and at what cost? What is the practical aspect of product liability as it pertains to software business packages? This session will answer these questions.

Chairman: Gordon French  
Commodore Business Systems  
901 California Avenue, Palo Alto, CA 94304

**Panelists:**

Panel members will be announced at the conference.

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3. Was the exhibition adequate? ☐ YES ☐ NO

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5. Because of the show, are you now going to buy a computer system? ☐ YES ☐ NO

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## Product Preview

# BIT PAD<sup>TM</sup> ... A New Graphic Data Entry Device

By Albert L. Whetstone

Maybe it's not polite to point, but pointing is a great way to put graphic information into your computer. BIT PAD\*, shown in Photo 1, is a new low-cost digitizing tablet developed by Summagraphics Corporation, which lets you just point at elements on a picture, drawing or chart and the tablet converts that point into digital coordinates.

Touching the pen-like stylus to the picture laid on the tablet produces the digital X and Y coordinates of that point. Or, if the stylus is moved along a line or curve, the BIT PAD produces a continuous stream of digital X and Y coordinate information (up to 64 coordinates per second). Architects, engineers and scientists use high cost digitizers to make electrical schematics and mechanical drawings, design buildings, create floor plans, lay out roads, help a computer read X-rays, and a host of other applications.

Summagraphics Corporation is the leading supplier of industrial graphic tablets and digitizers. Recently, Summagraphics has been able to redesign their industrial units into a low-cost, high performance digitizer ideal for the personal computer user. The BIT PAD has an 11" square digitizing area that takes only a 15" square desk space. The pen-like stylus is connected to a small 12½" control console cabinet.

You can choose a BIT PAD to resolve 200 points per inch or 100 points per centimeter, about the same resolution as Summagraphics' more expensive industrial digitizers.

BIT PAD can be used as a more reliable and versatile alphanumeric keyboard, by pointing to letters or numbers written on a BIT PAD overlay, or as an easier-to-use joy stick. Also, motion symbols: move up, move down, rotate CW, rotate CCW, can be printed on the tablet overlay and activated by touching the symbol with the stylus.

Until BIT PAD, there was no inexpensive and convenient method for the personal computer user to directly

convert drawings, pictures and other graphic material into digital form.

Logic involved to communicate between the BIT PAD and the computer is shown in Figure 1. The input and output data formats are shown in Figure 2.

Digital X and Y coordinates of the point touched by the BIT PAD stylus are generated by the BIT PAD electronics and output as five sequential 8-bit bytes. The format has been designed so that the BIT PAD is easily interfaced to the microcomputer industry standard 8-bit I/O ports. However, an RS232 interface is also available. The host processors can service the BIT PAD by operating either in the polled or interrupt mode. In addition to the 8 bits shown in the output format, Figure 2, a Data Strobe is generated for every byte. This data strobe can be used for interrupt driven systems. Positive or negative pulse is jumper selectable.

The BIT PAD receives all command information from the host computer through an 8-bit command. These commands include two handshake bits used for interface control (next Byte and Byte Received), two bits which can be used to control the operating mode of the BIT PAD, three rate bits which control the digitizing repetition rate, (when the front panel switches aren't used), and a status valid (SV) bit.

By reducing the BIT PAD price to less than 1/10th of the typical professional Digitizer/Tablet price (the basic BIT PAD system retails for \$555), Summagraphics has opened up a new spectrum of personal computer applications, ranging from super new games, to engineering and computer art. In fact, Summagraphics recognizes that the company can't think of all the ways to use BIT PAD and is offering \$1000 for novel applications that their users develop and have published in journals devoted to small computers.

For more information about BIT PAD and details about the application offer contact: Summagraphics Corporation, 35 Brentwood Avenue, Fairfield, Connecticut 06430, (203) 384-1344. □

\*BIT PAD is a registered trademark of Summagraphics Corporation





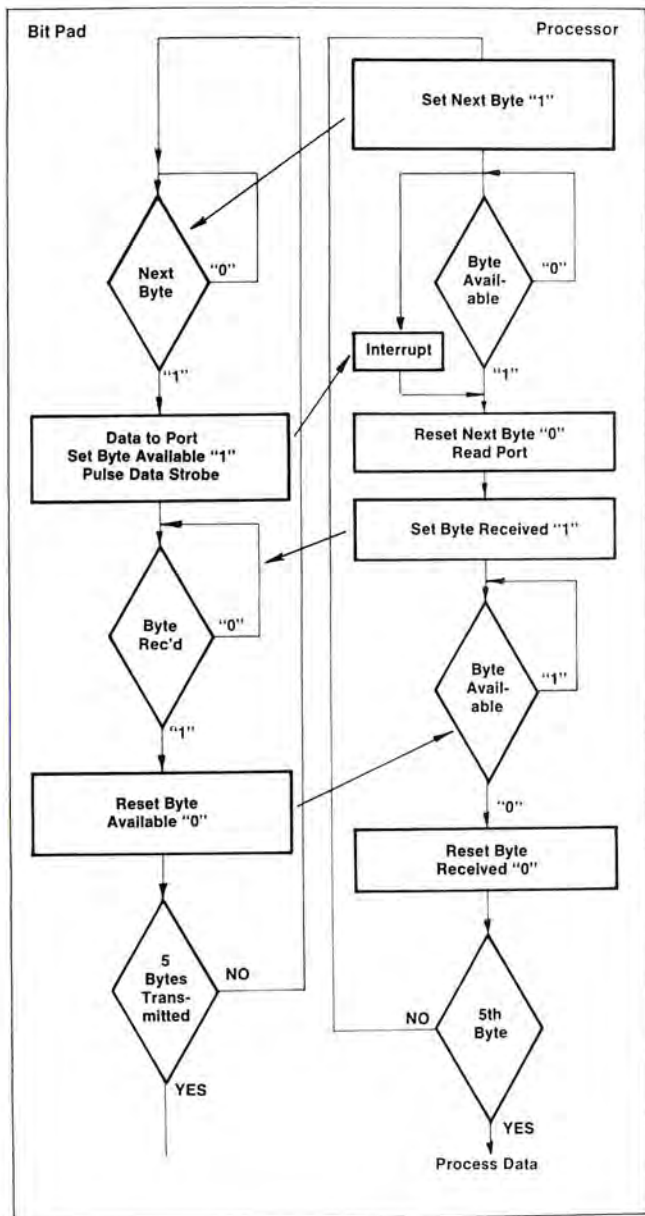


Figure 1. Handshake

## Operation

### Output Format

The formats of the five bytes are as follows:

The formats of the five bytes are as follows:

	MSB						LSB	
Byte 1	First Byte	Byte Avail	F <sup>3</sup>	F <sup>2</sup>	F <sup>1</sup>	F <sup>0</sup>	0	0
Byte 2	First Byte	Byte Avail	X <sup>5</sup>	X <sup>4</sup>	X <sup>3</sup>	X <sup>2</sup>	X <sup>1</sup>	X <sup>0</sup>
Byte 3	First Byte	Byte Avail	X <sup>11</sup>	X <sup>10</sup>	X <sup>9</sup>	X <sup>8</sup>	X <sup>7</sup>	X <sup>6</sup>
Byte 4	First Byte	Byte Avail	Y <sup>5</sup>	Y <sup>4</sup>	Y <sup>3</sup>	Y <sup>2</sup>	Y <sup>1</sup>	Y <sup>0</sup>
Byte 5	First Byte	Byte Avail	Y <sup>11</sup>	Y <sup>10</sup>	Y <sup>9</sup>	Y <sup>8</sup>	Y <sup>7</sup>	Y <sup>6</sup>

### Input Format

The format of the command byte is as follows:

The format of the command byte is as follows:

Next Byte	Byte Rec'd	Mode 2	Mode 1	Rate 4	Rate 2	Rate 1	Status valid
-----------	------------	--------	--------	--------	--------	--------	--------------

Figure 2. Operation



# MIO Board

By John K. Borders, Jr.  
Technical Engineer, Byte Inc.

*This article is excerpted from the original configuration manual, written by John, for distribution in all Byte shops. We are publishing this article for its technical value and to assist hobbyists who presently have the MIO Board.*

*Unfortunately, space does not permit the publishing of a facsimile of the MIO board. However, we felt that this would not present a problem for MIO board owners.*

—Editor

## INTRODUCTION

The MIO board itself is a very versatile and unique piece of equipment. Its features make it compatible with almost any S-100 bus based system and almost any software configuration. Since it has both serial and parallel ports, it can accommodate a variety of terminals either in unison or separately. Its on-board cassette interface saves the user the cost of yet another board for his system — a definite advantage.

The board is very difficult to configure and use, because of the MIO's versatility and amount of circuitry. The MIO manual has some inaccuracies and the language used in it is somewhat hard to understand. It is because of this, and also my belief that this is truly a workable board, that I have written this MIO configuration article. This article is designed to be used as a supplement to the MIO manual and is not intended to totally replace it.

I hope that this will help clear up the "mystery" behind making the MIO board "work."

## BOARD FEATURES

In any computer system there is need for input and output. The different software available and the different terminals, make the question of "what kind of I/O" a perplexing problem. Then, we have the need for mass storage. Cassette tape is cheap and versatile, but, which standard for recording? What speed to record at? And does this mean still another board for my overloaded power supply? The MIO board, with all its versatility, allows you to adapt it to any configuration you can dream up. On the same board is a complete cassette interface that can be configured for two different standards of recording and almost any transfer rate.

First, is the serial port. This is a complete, UART controlled, input-output serial port. The number of stop bits, byte length, and parity can all be jumpered to suit even a "picky" terminal.

The baud rate can be jumpered to all of the standard baud rates. The output and input can be jumpered for current loop, RS232, or TTL.

Second is the control port. This is a complete, parallel 8-bit, input-output port. The input side is available to all of the status signals for all of the ports. With this, the computer can "watch" the entire board from this one port. The output side uses 4 bits to control some of the internal circuitry. The other 4 bits are available for outputting strobes, controlling circuitry or anything else needed by the user.

Third, is the dual parallel port. There are two complete, 8-bit wide, input-output, parallel ports of the board. Both of these ports also have full handshaking logic. The two ports are at the same address and are "toggled" by use of the 4 bits from the control port.

Finally, is the cassette interface. This can be jumpered for all standard bit rates and has the capability of recording in two different methods — Tarbell and Byte-Lancaster.

All of that on one board, drawing less than one amp off the 8V bus! If you still don't think of the MIO board as a "marvel of engineering" then you haven't tried to put together a system with five different boards and software mods and hardware mods and headaches and...

## JUMPER AREA EXPLANATION

There are ten different jumper areas on the MIO board. Each one has its own special requirements and peculiarities.

During the entire article, when orientation is discussed, it will be assumed that the user has the board in front of him with the 100-pin edge facing down and the three 26-pin edges facing up. With this orientation, the regulator and heat sink will be in the lower left-hand corner.

**Jumper Area U1, direction jumper area.** This area is used to apply signals to the RS232 drivers and receivers. The left hand side of the socket has 8 pins. These 8 pins all go directly to the "SIO" edge connector in the upper left-hand corner of the board. Specifically:

U1 SOCKET	SIO EDGE CONNECTOR
9	3
10	5
11	7
12	9
13	14
14	11
15	21
16	15

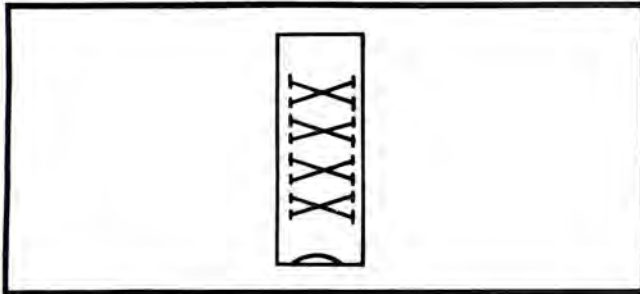
The right hand side of the U1 goes to the RS232 drivers and receivers. Specifically:

U1 SOCKET	RS232 DRIVERS
1	Receiver #4
2	Driver #4
3	Receiver #3
4	Driver #3
5	Receiver #2
6	Driver #2
7	Receiver #1
8	Driver #1

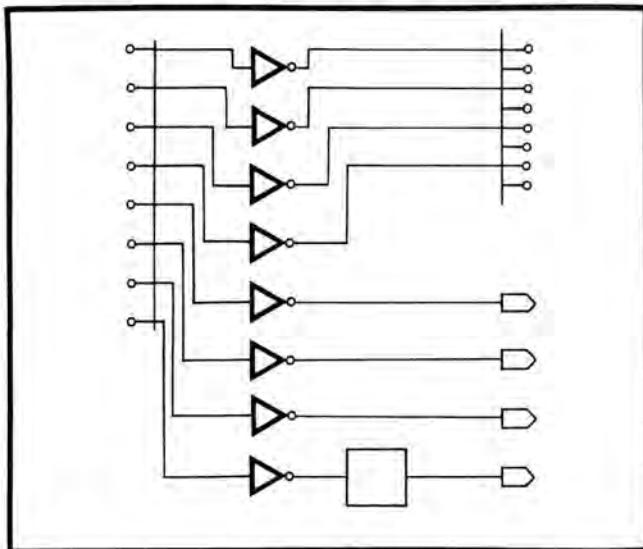
By running jumpers from the left-hand side to the right-hand side of U1, you can connect the RS232 drivers or receivers to any of the designated pins on the SIO edge connector. This allows a lot of freedom to adjust to non-standard terminals. Below is an example to configure this jumper area for most terminals. If you have a non-standard terminal, or are not sure, then you should trace the lines to your terminal and jumper the drivers or receivers to suit your specific needs.



# Configuration Manual



**Jumper Area U2, output jumpers.** This area is used to connect the output drivers to the signals that you want to output to your terminal. The 8 pins on the left-hand side of socket U2 are connected to the different output drivers. Pins 5-8 are connected to the four RS-232 drivers which in turn are connected to socket U1. Pins 2-4 are connected to three open collector drivers. The output from these drivers are connected directly to the SIO edge connector. Pin one is a special open collector driver which is used to drive a current loop circuit for a teletype. This current loop is further routed to the SU1 edge connector. To make the output clear:

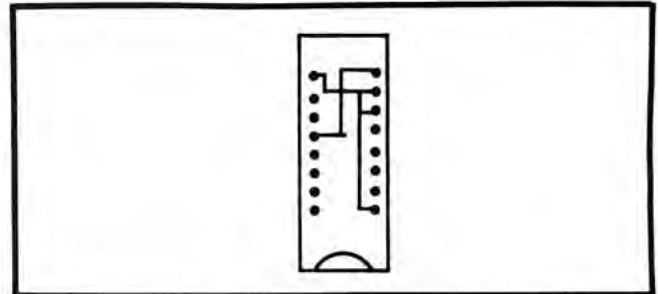


The left-hand side is connected as follows:

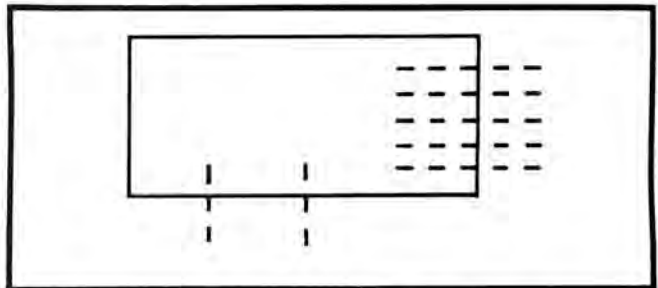
Pin #	Function
9	Connected to ground
10	Connected to SIO edge connector pin #2
11	Connected to SIO edge connector pin #10
12	TDATA output from UART
13	CR3 output bit 3 from control port
14	CR2 output bit 2 from control port
15	CR1 output bit 1 from control port
16	CR0 output bit 0 from control port

By connecting the TDATA output from the UART to the appropriate pin, you can drive almost any type of terminal from current loop to RS-232 to straight TTL.

Below is an example to configure this area for an ADM-3A or most any RS-232 interface:



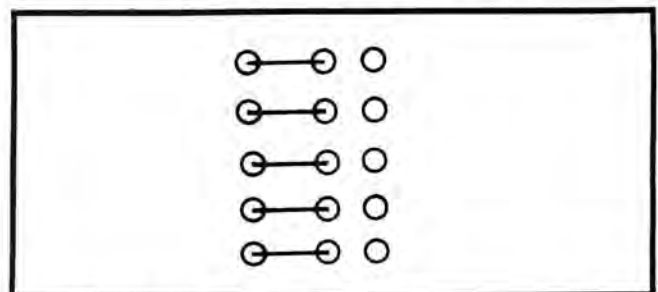
**Jumper Area T7, UART configuration.** This jumper area is located directly below 1C U7 — the bit 40-pin UART. It is organized as three columns, each with five pins. The leftmost column is tied directly to ground. The middle column is tied to +5V through a 1K resistor. The rightmost column pins are connected directly to pins on the UART chip. These pins control certain functions within the UART chip. Below is a diagram that explains what each pin does.



The bits/character is adjusted as follows:

W1	W2	BITS/CHARACTER
0	0	5
0	1	6
1	0	7
1	1	8

For most serial terminals, all of the UART pins will be jumpered to +5 (high). Below is an example.



## SIO BAUD RATE JUMPERS

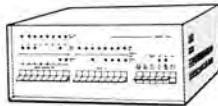
This consists of three jumper areas, actually. They are all located in the upper right-hand corner of the MIO board. Each area is composed of three columns, each with four pins. This makes a total of 12 rows. These rows are numbered from 0 to 11 starting from the bottom, and working up. The columns are labeled A, B, and C. The diagram below illustrates:



# BITS

# N

# BYTES



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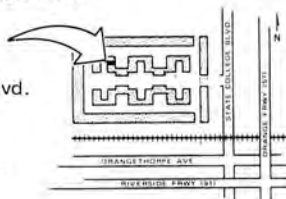
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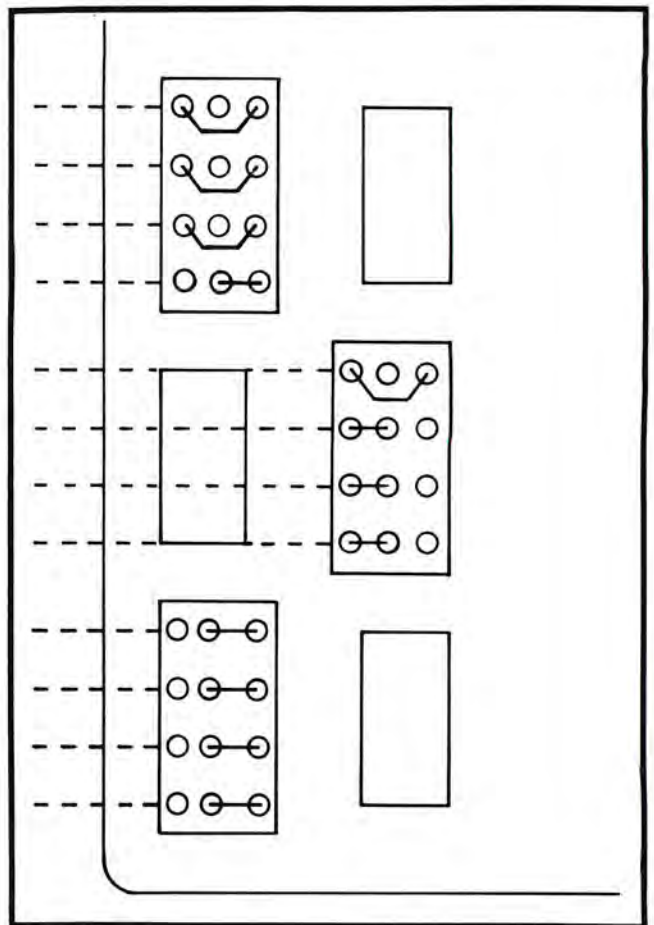
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There are a few things you must be careful of when configuring this section. First of all, you must understand that even though there are three different areas, they are treated as one unit, and the rows are numbered continuously from area to area. Second, you must be careful of the A, B, and C labels. The upper and lower areas have the "C" row on the left-hand side, and the "A" row on the right-hand side. However, the middle is exactly the opposite. The "C" row is on the right-hand side, and the "A" row is on the left. Keep this in mind as you configure this area.

Row A is connected to ground (0) and row B is connected to +5VDC (1) through a 1K pullup resistor. Row C is connected to the inputs of counters that are used to adjust the count rate to the UART. By jumpering row C to 0 (row A) or 1 (row B), the count rate, and therefore, the baud rate can be changed.

The jumper chart for this area is on page 2-19 of the MIO manual. Now that you know how this area is defined and the traps to watch for, you can follow the chart fairly easily.

**Jumper Area U19, board address jumpers.** This area is used to set the I/O port address of the MIO board. There are actually four ports on the board. This jumper area selects the address of the first port. The other three follow immediately after it in the addressing block. Pins 3-14 are used to select the address. Pins 1, 2, 15, and 16 are used to select the polarity for the cassette interface. The table for this jumper area is on page 2-7 of the MIO manual. For most systems that use low addressing (i.e. port 0 and 1) for their I/O, this jumper area can be left totally disconnected.

**Jumper Area U44, internal address jumpers.** This area is used to "re-arrange" the order of the four ports on the MIO Board. The four ports are:

Serial  
Control



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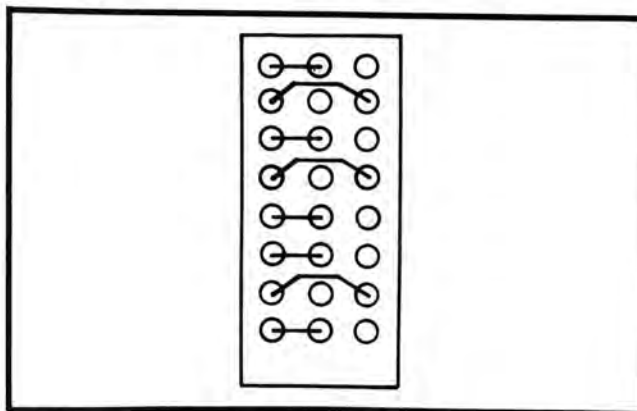
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## Parallel Cassette

By configuring the jumpers these ports can be placed in any order in the addressing scheme. The first port will have the address that is configured in the "address jumper area U19." The chart on page 2-8 of the MIO manual shows how to configure the jumpers. However, the comments in the chart are not correct. To be compatible with Processor Technology software, you should use the jumpers labeled "IMSAI SIO." Other than that, the chart should be followed to suit your system.

**Jumper Area TIO, CRI bit rate.** This area is located in the lower right-hand corner of the MIO board. It is used to adjust the baud rate of the cassette interface. It is organized as three columns of 8 pins. The columns are labeled A, B, and C, with "A" as the rightmost column, "B" in the middle, and "C" as the leftmost column. The rows are numbered from 0 to 7 starting at the bottom. The diagram below illustrates.



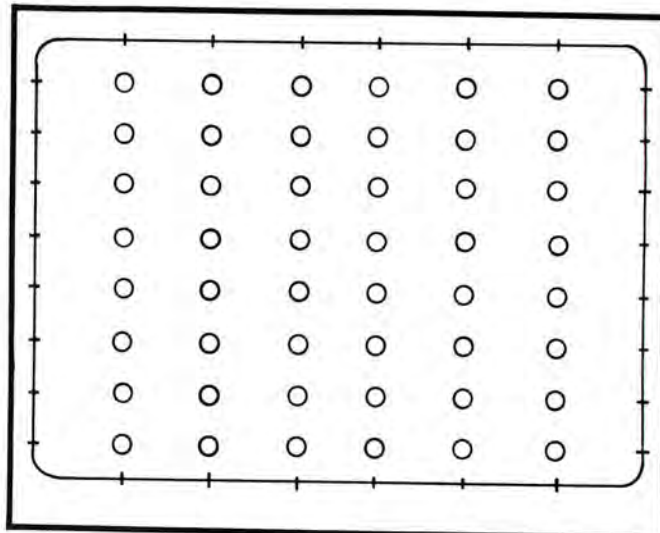
Column A is tied to ground (0) and column B is tied to +5V (1). Column C is connected as the input to a counter. By connecting column C to either ground (0) or +5V (1), you can adjust the bit rate of the cassette interface to suit your particular needs. The table of bit rates available is on page 2-31 of the MIO manual.

## INPUT JUMPER AREA

This area allows the user to connect a variety of input signals to the control input port, and set the interrupt vector.

The area is arranged as six columns, each with 8 rows. Each column has a special function, so each one will be treated individually.

Below is a diagram to guide you through the explanation:





**A — Control Input Port.** These eight pins are the 8 bits of the input side of the Control Port. By jumpering these pins to other areas the computer can monitor a variety of functions.

PIN #	FUNCTION
0	Control port bit #0
1	Control port bit #1
2	Control port bit #2
3	Control port bit #3
4	Control port bit #4
5	Control port bit #5
6	Control port bit #6
7	Control port bit #7

**B — UART Status.** These eight pins are connected to the status signals from the UART. By jumpering these pins to the control input port, the computer can monitor the serial port.

PIN #	NAME	FUNCTION
0	OE	UART overrun error
1	SIO	See Table 4, page 2-10
2	/RRDY	Inverse of RRDY
3	/TRDY	Inverse of TRDY
4	TRDY	Ready for transmit data
5	FE	UART framing error
6	RRDY	Received data ready
7	PE	UART parity error

**C — Parallel Port Status.** These 8 bits are used for a variety of functions.

PIN #	NAME	FUNCTION
0	RDATA	UART receive data input line. jumper to EIA driver for RS232 or current loop
1	CL1	Current loop input data jumper to RDATA to connect current loop to UART
2	PRDY	Logical OR of pin #4-3 of area C
3	PIOS	See Table 4 page 2-10 of MIO manual
4	I2DA	Parallel port 2 is ready for more output data
5	O2DR	Parallel port 2 has input data ready
6	I1DA	Parallel port 1 is ready for more output data
7	O1DR	Parallel port 1 has input data ready

**D — EIA and TTL Drivers.** This 8 bits are connected to EIA level drivers and TTL level drivers. By jumpering these to the UART, you can interface to almost anything.

PIN #	NAME	FUNCTION
0	REIA4	EIA receiver #4
1	REIA3	EIA receiver #3
2	REIA2	EIA receiver #2
3	REIA1	EIA receiver #1
4	CTIS	Byte ready from cassette
5	ITTL3	TTL direct input number 3
6	ITTL2	TTL direct input number 2
7	ITTL	TTL direct input number 1

**E — Ground.** All of these pins are tied to ground. They are meant to ground the appropriate "INT" pin to form the Interrupt Vector.

**F — Interrupt.** These 8 lines are connected to the data bus on the computer and are strobed on the bus during an interrupt. This provides a means to manually insert a 1-byte instruction into the computer on an interrupt. □

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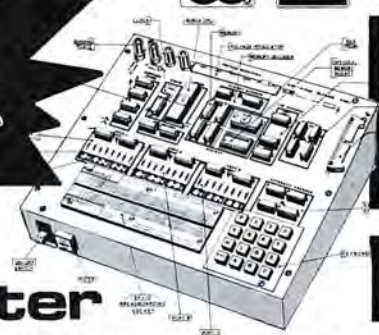
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INTERFACE AGE 99



# Computer Tutorial — Part II

## Storage Devices — Or, Memories Are Made of This

By Roger H. Edelson, Hardware Editor

This month we will take an overview of the many devices which have been, and are used as memory elements for a digital computer. As the field of computer memories is so vast, I expect to take two months of articles to give you just a glimpse of the technology. In this month's article we will have an overview of many different technologies. Some of them may be slightly surprising to you, but in almost all cases working memories have been built of all the elements I will cover. In next month's article we will delve more deeply into the technologies which make up the bulk of the memories found in the microcomputer field.

In considering memory technology and applications, one of the fundamental problems that comes to mind is the fact that the various technologies and applications overlap. This makes it difficult to characterize a particular memory technology into any specific category. For instance, it is possible to build either volatile, non-volatile, or permanent memories out of semi-conductors, and magnetic memories. While non-volatile memories may be either destructive or non-destructive depending on the particular element. Table 1 is the breakdown of categories that I will use for these articles.

First it is necessary to define the terms used in the category table before we can begin to discuss the memories themselves. *Permanent Memory*, one which can not be easily altered once the contents have been stored. *Non-Permanent Memory*, one whose contents may be altered by the user and new contents can be stored. *Volatile*, a memory whose contents will become unreliable once power is removed. *Non-Volatile*, a memory whose contents remain stored when the power is removed. This does not, however, mean that the memory cannot be erased. *NDRO (Non Destructive Read Out)*, a memory whose contents are not altered when those contents are accessed by the using device. *DRO (Destructive Read Out)*, a memory whose contents are disturbed by the reading process.

*Static* and *Dynamic* are two terms whose meaning is dependent upon the particular technology used.

### MAGNETIC DEVICES

A *dynamic memory* is one in which the magnetic medium, and its supporting structure, are moved physically to produce a signal describing the contents. A *static magnetic memory* is one in which no physical movement of the magnetic element, and its support must be moved.

### SEMI-CONDUCTOR DEVICES

When referring to semi-conductor memories, a *static memory* is one whose contents will remain stable so long as power is applied. A *dynamic semi-conductor memory* is one in which the contents slowly fade away unless constantly rewritten, or refreshed.

### PERMANENT MEMORIES

Let's begin our memory survey with a look at the

various *permanent memories*. Punched paper tape and Hollerith (IBM) cards are two examples of a *permanent memory*. Both are easy to load and fairly easy to read. Barring accident, the contents will remain unchanged. If an error is made in storing contents in either of these media, corrections can be made with tape and a manual punch. Hardwired memories, such as diodes, or wired transformers (cores), are not as prevalent as the paper memories, but they are generally less accident prone. In particular some very compact, highly reliable *permanent memories* have been built using the wired core-transformer element.

---

**This does not, however,  
mean that the memory  
cannot be erased.**

---

The semi-conductor *permanent memories* either configured as a ROM (Read-Only Memory), or as a PROM (Programmable Read-Only Memory), are probably the devices most of us think of when we hear *permanent memory*. Various semi-conductor technologies can be used to produce a ROM or PROM, and we will discuss these in depth in a later article. The ROM version can be built by having the factory pre-program the device, after manufacture but before shipment to the user. A ROM may also be constructed by having the contents set up during the manufacturing process by means of the metallization mask. These devices are called mask-programmable ROMs. They provide the lowest cost method of fabricating a semi-conductor *permanent memory*, but you had better be very sure of the memory contents before you commit to a mask programmable device. The cost of the mask is not cheap. Also, these masked devices are selected when a large quantity of memories is to be purchased.

### NON-VOLATILE MEMORIES

By far the most varied branch of memories is the devices which make up the *non-permanent memory* technology. To ease our consideration of this group we will divide it into volatile and non-volatile memories. The volatile branch contains some of the more exotic members of memory devices, so let's begin our discussion with the non-volatile devices. Until recently almost all non-volatile memories used a storage based on a magnetic element. Semi-conductor technology has changed this picture, but we shall still begin with the *magnetic memories*. Basically, all magnetic memories depend on



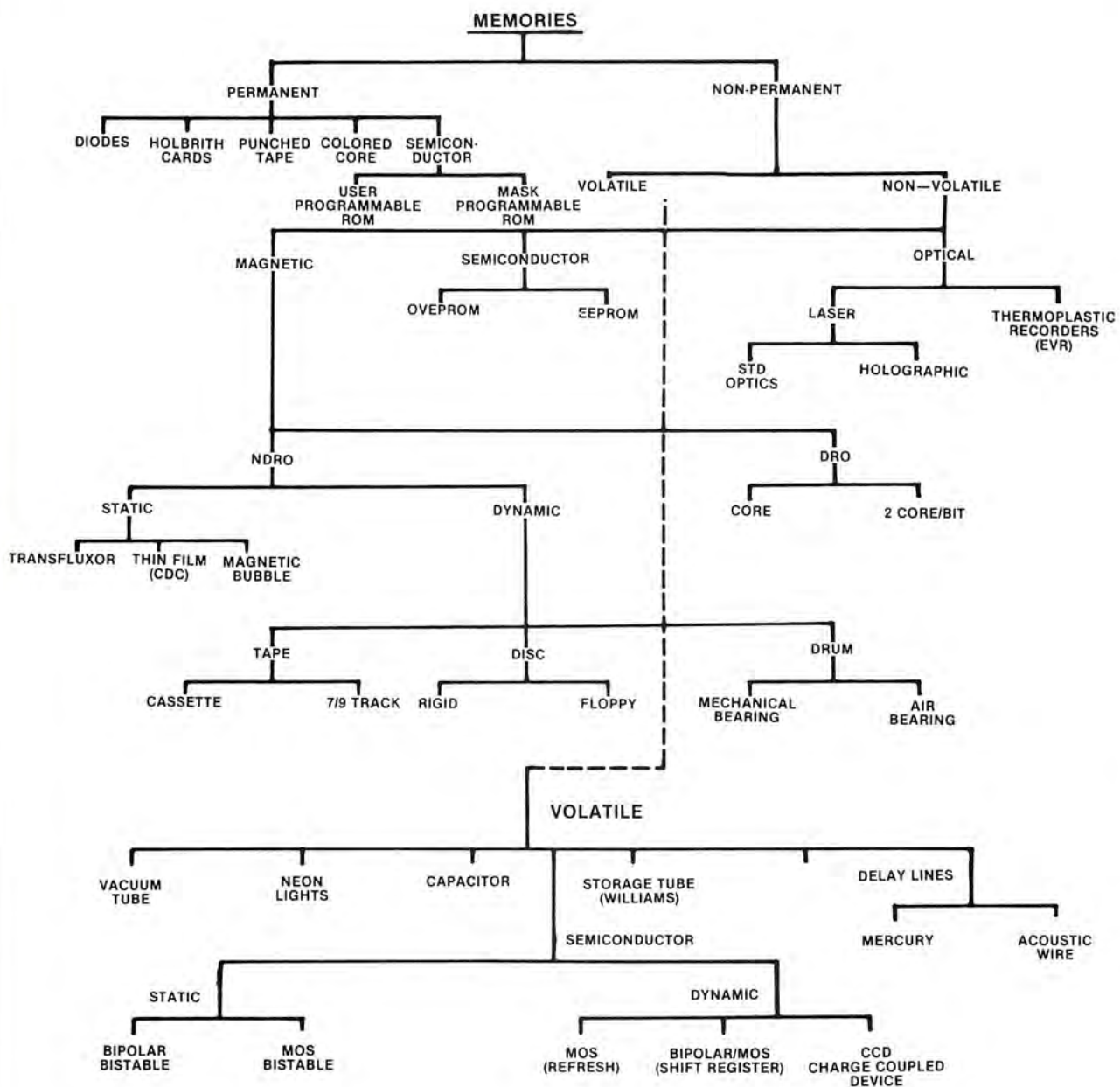


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the fact that if a magnetic element is placed in one position, it will remain with its north and south poles in that direction, until the orientation is changed by the application of another external field. This simplistic statement neglects domain walls, and other more esoteric components of magnetic theory, but for our purposes is a sufficient working rule.

The major differences between *magnetic memories* occurs in the method used to sense the orientation of this magnetic dipole. In destructive read out (DRO) memories the dipole orientation is sensed by always attempting to change its direction to a previously established rest direction. If the dipole were oriented opposite to the rest direction, a signal will be generated when the dipole is flipped. Should the orientation be identical to the rest direction, no output signal will be generated, as no magnetic lines of flux are generated. However, in this case, the contents of the memory are altered by the application of the field which reverses the direction of the magnetic dipoles, storing one state of information.

All single hole per core magnetic elements are in the DRO class. These types of core memories can be further classified, depending on the methods used to address the individual elements, and the number of cores per bit. If we add one more hole to the core, and orient it so that the axis of the two holes are orthogonal (right angled), a device is formed which is capable of being used as an NDRO, non-destructive read out, memory.

The non-destructive properties of this device are due to: A sensing field, applied through one of the holes, can provide information on the direction of the magnetic dipoles, around the orthogonal hole. This is accomplished without disturbing the stored dipoles direction. This device is called a *transfluxor*. The *transfluxor* is one of a class of magnetic NDRO memories that is static. In other words, the *transfluxor* does not have to be physically moved to produce an output signal, only the store field is partly rotated.

Another static magnetic NDRO, much the same as the *transfluxor*, is a thin-film memory produced by CDC. To form this memory element two different magnetic films are sputtered onto a glass substrate. One film is made up of a hard magnetic alloy (one that is difficult to re-orient). The other film is a softer alloy and is placed over the hard film. Information is stored by setting the hard film into the appropriate direction. The soft film tracks the dipole direction of the harder alloy. The stored information is sensed by providing a field just strong enough to flip the soft film, but the hard film retains its orientation. If the soft film changes direction, an output signal is produced indicating the storage of same data. After the sensing field is removed, the soft film will revert to the orientation stored by the hard film. As might be expected, this device does have an upper limit on the number of reads (greater than 10<sup>6</sup>). Basically, this is a very reliable NDRO memory. However, it is extremely expensive to produce.

Another magnetic, static NDRO that is just now starting production is the magnetic bubble memory. This memory operates by the propagation of magnetic domain bubbles through a medium. It is a bulk-storage device that will rival magnetic tapes in a few years. As the technology is just being refined and developed, the prices of this element should begin to drop rapidly in the next two to three years. Also the availability will increase. Currently, the only commercially available devices are being produced by Texas Instruments.

The more familiar magnetic NDRO memories are the dynamic, or moving medium, types. In this class we find the magnetic tapes, disks, and drums. All of these memories depend on moving the magnetic dipole physi-



cally, rather than rotating the dipole magnetically. The theory of operation of these devices is similar to the generator or alternator in your car.

Magnetic tapes may be either cassette or the larger 7/9 track types. Information may be recorded either in an audio (analog) form or digital format. Many different types of storage techniques have been developed to increase the density of the recording information, and the reliability of the recording.

The disk storage elements may either be rigid, or the more familiar floppy (flippy) types. Again, various different methods are used to optimize this technology.

The magnetic drum is no longer widely used as a memory device. Magnetic drum memories have been built with fixed head to drum spacing, or with heads which flew on an air cushion over the drum surface. The drum bearings are normally the mechanical type which we are all familiar with. However, there have been some drums in which an air-bearing was used to reduce the friction, and consequently the driving force. As might be expected, a great deal of difficulty was experienced in making an air-bearing drum operate reliably.

Returning to the general class of non-volatile memories, there are at least two other technologies that allow construction of a non-permanent non-volatile memory, optical or semi-conductor.

Optical based memory systems usually depend on the storage of information in a thermoplastic medium. An optical device was built by Motorola, using this technique for the storage of video information. The technology never caught on, and surplus units may be found for only about \$100 for interested experimenters. These units will read only, using a small scanning oscilloscope with photocell output.

Permanent memories can also be built using optical based techniques. Either a scanning oscilloscope, or a laser can be used as the addressing element. The information can also be stored in conventional films or in holographic records.

More familiar to microcomputer buffs are the non-permanent non-volatile memories, using semi-conductor based technology. These are the EPROMs (erasable programmable read only memories). EPROMs are programmed by applying an overvoltage which sets internal charge layers. The erasable EPROMs found in the typical home computer are usually 1702 or 2708 types, which are erasable through the application of ultraviolet light. In many applications, a system is designed and debugged using UV-erasable EPROMs. The EPROMs are then replaced with ROMs in the production phase. Another device, manufactured by at least three companies, is an electrically erasable EPROM (EEPROM). Nitron (a division of McDonnell Douglas Corp.), Burroughs and NEC Microcomputers, Inc., produce a device of this type.

## VOLATILE MEMORIES

That about covers the non-volatile, either permanent or non-permanent, memory devices. We will now turn to the volatile memories, of which the semi-conductor types comprise the largest and most familiar class. However, before looking at the more familiar volatile semi-conductor memories, let's review some of the stranger types that have been used in past computer systems.

One type of device that enjoyed great usage during the beginning of the digital computer era was the Williams storage tube. With this memory, the information was stored as a light spot on the face of an oscilloscope. The tube was built as a storage scope, using a flood gun and a storage mesh just behind the face plate. Electrical interaction maintained the light, or non-light, condition of the phosphor. The contents of the memory

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were dynamically refreshed to prevent the ultimate deterioration with time.

Delat lines were also used to store information; with mercury ultrasonic, or long wire acoustic lines being popular. These devices can be considered to act like short tape loops with the exception that the information must be continually recycled.

Capacitor arrays have also been used to build memory systems. These offered some advantages in that they were a little easier to read and write than magnetic cores. However, their volatility and large size make them impractical for most uses. Because of their low cost and bi-state characteristics, neon lights have also been used as memory elements. One had to, in all cases, use the devices containing a small amount of a radioactive substance, because lamps without this source of radiation would exhibit different characteristics when subjected to varying degrees of light.

Vacuum tubes arranged as bistable elements were used for a long time as memory elements. An interesting problem occurred in these memories. The cathode emission characteristics of the tube would change drastically if the tube were in the "OFF" state for a long period of time versus the characteristics associated with the "ON" state. The problem would manifest itself by unreliable memory operation. The cure was to arrange for some period of time when all tubes would be "ON."

Originally, semi-conductor memories were just copies of the vacuum tube flip-flops. The major advantages of semi-conductors were low power (no filament), small size, higher reliability (both physically and electrically), and ease of construction. Additionally, semi-conductors more closely approached the perfect switch. Consequently, their off and on states were more easily distinguished. Semi-conductors did suffer from problems due to high temperature environments and speed.

The advent of integrated circuits ushered in the true ability of semi-conductor memory elements. At first tens, then hundreds, of flip-flops were placed on one chip. At last an element had been found that could compete with the core memories. The first integrated circuit memories were static types based on the flip-flop. It was later found that charge could be stored for a considerable length of time in the high dielectric of a MOS transistor. This led to the development of the high capacity *dynamic semi-conductor memories*. These memory elements need a continual refresh cycle, to maintain the content. Because of this characteristic, *dynamic semi-conductor memories* have a non-zero error rate. For many applications, this is significant. As a result, military systems are generally built using only static memories because of this problem. In home computers, the slight error rate can usually be tolerated, or reduced, using parity error checking techniques.

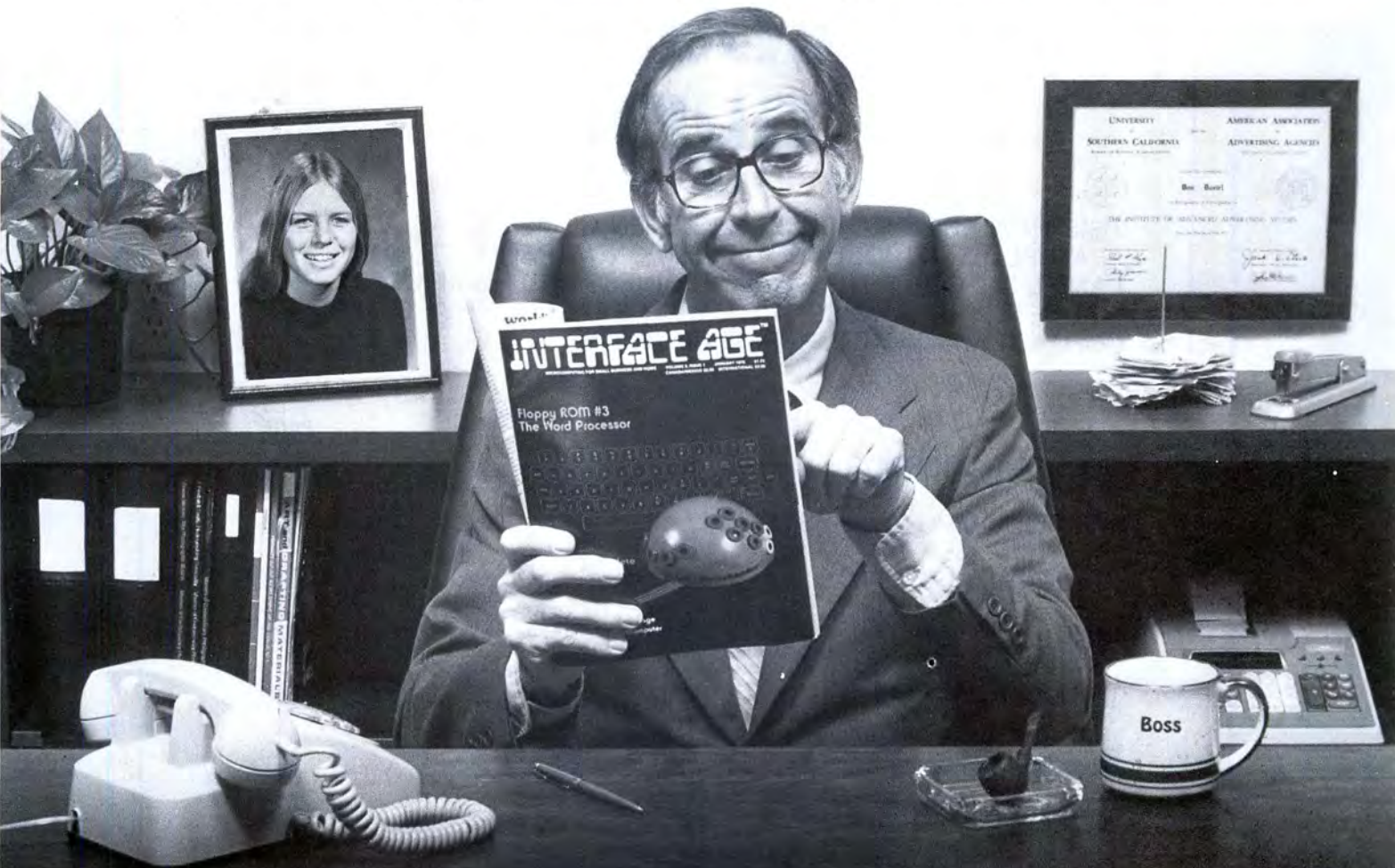
The newly emerging field of *charged-coupled devices* is now offering memories with the highest storage densities of any non-permanent semi-conductor element. At present 16K bit *CCD serial memories* are available, and 64K bit devices are on their way. These devices are usually organized as groups of parallel recirculating serial shift registers. This organization maintains a low average latency time (access time to any given bit in the memory), with a reasonable output decoder structure. The readout is non-destructive and the refresh circuitry is usually provided on the chip. To move the charges along, a four phase clock is generally required, somewhat complicating the drive circuitry.

That completes our Cook's tour of the quite prolific memory world. Next month, we will delve somewhat deeper into the organization and technology of the memory devices generally favored by the home and small computer enthusiast. □



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THIS NEW PRODUCT GUIDE HAS BEEN COMPILED AS A SPECIAL FEATURE TO INTRODUCE THE MANY NEW PRODUCTS AND COMPANIES ENTERING THE SMALL BUSINESS AND HOME COMPUTING MARKET. YOU CAN USE THE HANDY READER SERVICE CARD OR CONTACT MANUFACTURERS DIRECTLY.

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# Microprocessor Kits

## 8700 CPU Board

PAiA Electronics, Inc. announces the introduction of their 8700 Computer/Controller; the OEM microprocessor development system.



Based on the popular 650x family of processors, the 8700's fully socketed, plated through board provides space for 1K bytes of RAM in 256 byte increments (2112) and 1K bytes of PROM also in 256 byte increments (1702A), five 8-bit parallel input ports and one 8-bit parallel output port. Several connectors are provided for system expansion and the implementation of more complex I/O structures.

Currently available options include the PS-87 Power Supply (\$24.95) and CS-87 Cassette Interface (\$22.50) which also provides on-board software and hardware relay drivers for tape motion control.

The PAiA 8700 is available both in kit or assembled form in a wide variety of low-cost configurations starting at less than \$90.00. For more information contact PAiA Electronics, Inc., OEM Sales, 1020 Wilshire Blvd., Oklahoma City, OK 73116.

CIRCLE INQUIRY NO. 111

## 4MHZ Z80A Processor Board

North Star Computers, Inc., has available a 4 MHZ Z80A processor board (ZPB) for use in S-100 bus computers. The ZPB board is one of a number of high-performance products North Star Offers for S-100 bus computers.



Other features of this versatile and fast board include auto-jump startup and vectored interrupts. Available as a kit for just \$199 or \$259 fully assembled. EPROM option costs are \$49 for kit and \$69 assembled. For additional information contact North Star Computers, Inc., 2547 Ninth St., Berkeley, CA 94710, (415) 549-0858.

CIRCLE INQUIRY NO. 112

## A High-Performance Microprocessor for Data Communications

The new microNOVA family by Data General gives communications system users minicomputer performance and software, together with microprocessor economy and packaging. The

first 16-bit microprocessor designed and manufactured by a major minicomputer maker, microNOVA has a number of features that make it well suited to low-end data communications network components like data entry terminals and line concentrators. A range of advanced development and runtime software, high-speed I/O system with data channel capability, large memory capacity, high performance MOS technology, and a variety of interfaces support easy integration into communications configurations.

In a typical small data entry or order processing system in a distributed network, microNOVA programmability and powerful instruction set allow easy adaptation to varying line procedures. The hardware system stack supports nested subroutines for complex multiterminal operations. For large terminal systems, microNOVA supports up to 32K words of RAM/PROM memory. Non-volatile PROM, available in 512, 1K, 2K, and 4K increments, is ideal for fixed storage or remote program load in unattended operations.

For more information contact Data General Corp., Southboro, MA 01772, (617) 485-9100.

CIRCLE INQUIRY NO. 110

## Z80 Board for SWTP

This Z80 MPU card replaces the SWTP 6800 card and enables you to use Z80/8080 software in your SWTPC.



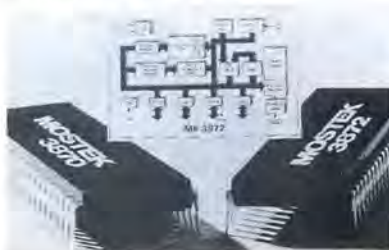
On board ROM replaces MIKBUG with Z80 software. Now you can use the abundant 8080 and Z80 software without buying another computer. Uses two MPS cards or the 2SIO(R)6800 card for I/O. Controls terminal and one or two tape units from the ROM at baud rates up to 9600 (2708 EPROM).

Z80 software is available, including an excellent 6K Basic with strings and trig functions. For further information contact National Multiplex Corp., 3474 Rand Ave., Box 288, So. Plainfield, NJ 07080, (201) 561-3600.

CIRCLE INQUIRY NO. 113

## Mostek Adds New Microcomputer

Mostek Corporation has a new single-chip microcomputer, the MK3872. The 3872 is an expanded version of Mostek's 3870, having twice the 3870's ROM and RAM.



Features of the 3872 include 4032 x 8 bytes of mask programmable ROM; 64 bytes of scratchpad RAM and an additional 64 bytes of executable RAM. Supporting the executable RAM is a stand-by power mode for easy battery backup.

These characteristics enable the 3872 to control sophisticated mechanical devices and instruments. Or the 3872 may be used to combine several programs into one system. In applications that require non-volatile data storage, the standby power mode makes expensive CMOS memories unnecessary.

The MK 3872 will be available for prototyping by mid-second quarter 1978 with pricing to be announced in the first quarter of 1978. For more information contact Mostek Corp., 1215 W. Crosby Rd., Carrollton, TX 75006, (214) 242-0444.

CIRCLE INQUIRY NO. 114

## Intel Announces A Single-Chip Microcomputer

The 8049/8039 single-chip microcomputers contain all elements of a computer, including memory, on a single "chip" of semiconductor material.



The 8049 is intended for those applications which exceed an on-chip 1024-byte program memory and 64-byte read/write memory capacity. Designs that need the larger read/write memory but no on-chip program memory can use the 8039.

The 8049/8039 can also be expanded using Intel's universal peripheral interface component, the UPI-41™, with the architecture required to operate as an "intelligent slave." The UPI-41 interfaces and controls printers, keyboards, display, etc. For more information contact Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 249-8027.

CIRCLE INQUIRY NO. 115

## Digital Announces LSI-11/2

The new, low-cost LSI-11/2 modules are software compatible with the LSI-11, and offer configuration price savings to 44 percent below existing products. The key element of the new family is the LSI-11/2 central processor, which is mounted on a 5 by 8½-inch module.





The LSI-11/2 family includes a variety of memory modules with the same half-width size as the central processor, and a matching-width cardguide and backplane assembly. Interface options are also available. The LSI-11/2 is available in 4, 8, 16, and 32K word memory configurations, with optional byte parity.

The LSI-11/2 central processor module, designated the KD11-HA, is also available by itself in quantities of 50 for applications requiring custom RAM or ROM configurations.

For more details contact Digital Equipment Corp., Components Group, 1 Iron Way, Marlborough, MA 01752, (617) 481-7400, ext. 6084.

CIRCLE INQUIRY NO. 116

## microNOVA Family Gives Control Users Minicomputer Features

The new microNOVA line from Data General brings industrial users minicomputer performance in a microcomputer, combining features like 16-bit architecture, powerful I/O structure, field-proven software and large memory capacity in a microcomputer.

Data General's new microNOVA computer family is based on the mN601 microprocessor, designed and manufactured in-house. This 40-pin ceramic package is a full 16-bit central processor with multiple register architecture and a powerful instruction set. Multiple addressing modes give 32K-word addressing and maximum program flexibility. N-channel, sili-

con gate MOS circuit technology allows the fast execution speeds necessary for real-time environments. Memory cycle time for microNOVA computers is less than one microsecond.

The microNOVA computer-on-a-board is a complete, functional 4K-word microcomputer on a 7½ x 9½-inch printed circuit board. The microprocessor can be the heart of a 9- or 18-slot microNOVA minicomputer with front console, up to 32K words of memory, DMA data channel capability, power fail/auto restart, multiply/divide and real-time clock, all standard, in a rack-mounted chassis 5¼ inches high and 14½ inches deep.

For further information contact Data General Corp., Southboro, MA 01772, (617) 485-9100.

CIRCLE INQUIRY NO. 117

# Microcomputer Systems

## Challenger IIP

This personal computer is complete with BASIC in ROM and RAM (4K) for programs in BASIC. Challenger IIP is fully self-contained with a full size keyboard and a 32 x 64 character video display interface.



Complete with an audio cassette interface, the Challenger IIP user simply connects a video monitor or home TV set via an RF converter (not supplied) and optionally a cassette recorder for program storage.

Challenger IIP is the ideal personal computer for the beginning hobbyist (without disk), the educator because it's crash proof and the small business man in a complete system with a disk.

Challenger IIP comes complete with a 4 slot backplane and case for \$598.00 fully assembled, and is expandable via compatibility with all Ohio Scientific Accessories. For more information contact Ohio Scientific, 11681 Hayden, Hiram, OH 44234, (216) 569-7905.

CIRCLE INQUIRY NO. 137

## Horizon — The Complete Computer

A complete, high-performance microprocessor system with integrated floppy disk memory is now available from North Star Computers, Inc. Called HORIZON™ the system is designed for business, educational and personal applications.



Horizon is ready for programming in extended disk BASIC with the addition of a CRT or hard-copy terminal.

North Star supports the Horizon with addi-

tional S-100 boards including a hardware floating point option at \$259 kit; \$359 assembled; and 16K RAM boards at \$399 kit, \$459 assembled, with optional parity check and additional serial and parallel I/O ports at \$39 kit and \$59 assembled.

HORIZON-1: \$1599 kit; \$1899 assembled. HORIZON-2: \$1999 kit; \$2349 assembled. Delivery is 30 days ARO. For more details contact North Star Computers, Inc., 2465 Fourth St., Berkeley, CA 94710, (415) 549-0858.

CIRCLE INQUIRY NO. 139

## The Bytemaster

The Digital Group's integrated computer package, the Bytemaster, will be available for shipment May 1, 1978. The Bytemaster features either 18K or 32K memory, but will support up to 64K memory if desired.



Dressed in a professional metal cabinet that is mounted on a heavy duty metal yoke, with prices starting at \$1,995 for the Master 1 model, (Digital Tape, 18K, Kit), the Bytemaster is the latest addition to Digital Group's line of personal computers.

For details on the Bytemaster contact The Digital Group, Inc., P.O. Box 6528, Denver, CO 80206, (303) 777-7133.

CIRCLE INQUIRY NO. 138

## Datasystem

The DEC DATASYSTEM 308 features a combined terminal and processor, floppy disk storage, and a choice of printers.



Designed primarily for small businesses requiring only a single terminal and programming language, the Datasystem 308 operates from ordinary current and requires no special "computer room" environment. Data and program files for the new Datasystem are compatible with the larger Datasystem 310, and an optional word-processing program package is available for the 308.

For further information contact Digital Equipment Corp., Maynard, MA 01754, (603) 884-5101.

CIRCLE INQUIRY NO. 135

## Challenger III

Challenger III comes standard with the OS-65D Disk Operating System and is equipped with three microprocessors to run 6800, 6502, 8080 and Z-80 programs. Ideal for educational applications, students can study the three microprocessors for programming and engineering analysis.



Small business applications is another use for Challenger III. Businessmen can utilize software packages written for any of the three microprocessors while conducting everyday business functions on the computer.

Industrial development is another area where Challenger III can be utilized for the investigation and comparison of the three processors. A 74 megabyte disk option makes mass data storage a reality for the experienced user.

Challenger III is fully compatible with all Challenger hardware and software and is available from Ohio Scientific, 11681 Hayden, Hiram, OH 44234, (216) 569-7905.

CIRCLE INQUIRY NO. 136

## ABACUS for Insurance Agents

Minicomputer Systems Technology, Inc. (MST) announces the availability of its minicomputer system, ABACUS (Agents and Brokers Automated Computer Users System), a complete in-house minicomputer system for insurance agents and brokers.

The ABACUS system provides an agent with an automated tool which allows the cost effective management of an agency, and also pro-



vides sales information to help market agency products. The system contains several independent modules for billing, accounting, reports and more.

ABACUS consists of more than 140 programs and is written in a tutorial, self instruct manner that allows the non-technical user to pick the job, or function to be done from lists displayed on the video screen.

ABACUS is installed as a turnkey system with a 32KB memory and from 1 to 32 video input screens. Disk size ranges from 500KB to 88MB, and the system will support one or more printers; therefore, ABACUS accommodates agencies with 500 to 70,000 customers and 1,000 to 100,000 policies.

A single user ABACUS system starts at \$35,500 or leases for \$760 per month. ABACUS is sold exclusively by Minicomputer Systems Technology, Inc., 137 Ferry St., Everett, MA 02149, (617) 389-3800.

CIRCLE INQUIRY NO. 133

### Super System 16

Technico, Inc. has a new complete 16-bit microcomputer system based on the T.I. TMS 9900. Called the Super System 16, it uses as its CPU board the existing Technico Super Starter System with prices starting at \$299. An assembler, editor linking loader and BASIC is available on the system.



The system is available with 65K bytes of memory, dual floppy disk up to 192 bit of bi-directional I/O and a video graphics board. The system is sold both assembled and in Tec-Kit form. An assembled and tested 10K byte system sells for \$1349.00. The unit is available in hobby stores.

For further information contact Technico, Inc., 9130 Red Branch Rd., Columbia, MD 21045, (800) 638-2893.

CIRCLE INQUIRY NO. 134

### Z-2D Disk Computer System

The Z-2D is a professional system that comes equipped with a 5" floppy disk drive and controller. The Z-2D also comes with Cromemco's 4-MHZ CPU card, the Z-2 chassis with 21-slot motherboard and a 30-amp power supply.



The Z-2D is available with one disk drive for \$1495 in kit form and for \$2095 assembled and tested. An additional disk drive is available for \$495. For additional information contact Cromemco, Inc., 2400 Charleston Rd., Mountain View, CA 94043; (415) 964-7400.

CIRCLE INQUIRY NO. 130

### Single Board Computer from Intel

The new SBC 80/05 Single Board Computer is priced by Cramer at less than \$200 in OEM quantities. The new computer also offers original equipment manufacturers comparable savings in system power through operation on a single +5V-volt power supply.

The SBC 80/05 is designed to facilitate the splitting up of complex systems, such as industrial process control and instrumentation systems, into a series of "intelligent" subsystems.

It is available immediately from Cramer at a single unit price of \$350. The new SBC 80P05 Prototyping Package costs \$895 in single unit quantities. For further information contact Cramer Technical Literature Center, 85 Wells Ave., Newton, MA 02159, (617) 969-7700 or call any nearby Cramer distribution center.

CIRCLE INQUIRY NO. 132

### More for Desktop Computer

Additional memory, a choice of printers, and a large character set are now available with NCR Corporation's 7200 Model VI desktop computer.



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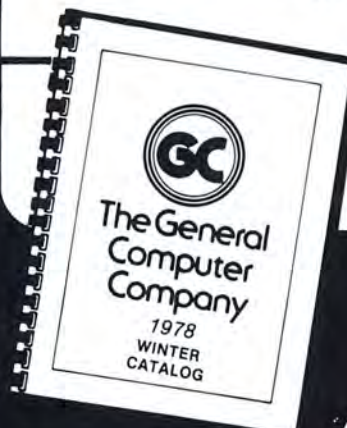
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CIRCLE INQUIRY NO. 70



The fully programmable 7200 is now available under a rental plan. A system including 24K processor, magnetic tape cassette, thermal printer and BASIC (Beginner's All-purpose Symbolic Instruction Code) software rents for \$327 per month.

The desktop computer was developed primarily for schools and colleges, department-store chains, savings and loans institutions, and service bureaus.

A basic version of the NCR 7200 Model VI, including a 9-inch visual display terminal, control module, keyboard and cassette tape recorder as well as BASIC + 6 software, is priced at \$6,695. For further information contact NCR Corp., Dayton, OH 45479, (513) 449-2150.

CIRCLE INQUIRY NO. 128

### REX Personal Computing System

REX — The Total Microcomputer System, fully assembled, complete with a Z-80 CPU,

24K of RAM, video output, system keyboard, a microfloppy disk drive featuring double-sided recording, cabinet and power supply and optional Extended Disk BASIC and ANSI FORTRAN IV.



The REX system includes an S-100 motherboard containing the CPU, up to 64K of RAM

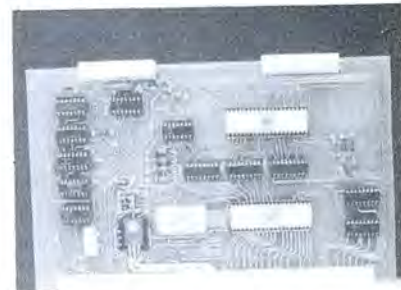
(24K standard), video display interface, bootstrap and Monitor PROM, and powerfail and vectored interrupt circuitry. The system comes complete with a modern walnut-sided cabinet and a 15 amp power supply and includes space for a second microfloppy drive plus five slots for S-100 bus options.

The REX system lists for \$2495, assembled and tested only. For further information contact Realistic Controls Corp., 404 W. 35th St., Davenport, IA 52806, (800) 553-1863, toll free.

CIRCLE INQUIRY NO. 129

### CPU-1

The CPU-1 is a central processor board using the MOS Technology 6502 and the 6530-004 TIM monitor ROM. It can use crystal controlled or RC clock (on board). The CPU-1 has eight general purpose I/O lines and 2 handshake lines to interface a reader, ASCII keyboard or other device. The TIM monitor can use this port for high-speed input.



The board includes provisions for a 2704/2708 or 2716 EPROM for program or subroutine storage. The EPROM can control startup from reset if desired and the TIM subroutines are still available for use. Plugs into SWTPC or equivalent SS50 bus. Compatible with SWTPC 6800 memory and interface boards and our VDB-1 video display board.

Bare board and documentation \$29.00 plus \$2.50 per order for shipping and handling. (Documentation only \$5 ppd., refundable with later purchase. Ohio residents add 4% sales tax. For further information contact F. & D. Associates, Box 183, 1270 Todd Rd., New Plymouth, OH 45654, (614) 385-2023.

CIRCLE INQUIRY NO. 131

### Microcomputer with Double Density Floppy

Designated the Micro-2, this compact system is housed in a single cabinet with two Shugart floppy disk drives. The single computer board features a Z-80 CPU, 32K or 64K RAM, four RS232 serial interfaces, and real-time clock.

The disk controller can use either IBM 3740 format or a double density format of 571K bytes per diskette (77 tracks of 58 sectors with 128 bytes per sector). With optional double sided drives, the system can store up to 2.3 megabytes.

The Micro-2 comes complete with both the comprehensive CP/M disk operating system and complete hardware diagnostics. Extensive accounting software is available. Other software, including CBASIC, BASIC-E and FORTRAN is also available.

For further information contact Digital Systems, 6017 Margarido Dr., Oakland, CA 94618, (415) 428-0950.

CIRCLE INQUIRY NO. 127

### Computerized Road Test System

This Computerized Road Test System has many advantages over previous systems. First, the weight of the equipment is 75% less, about 25 pounds. There is also no requirement for a data taker as a passenger. This eliminates the weight of an uncomfortable passenger from the vehicle as well as his cost in support of the test, and makes possible performance testing

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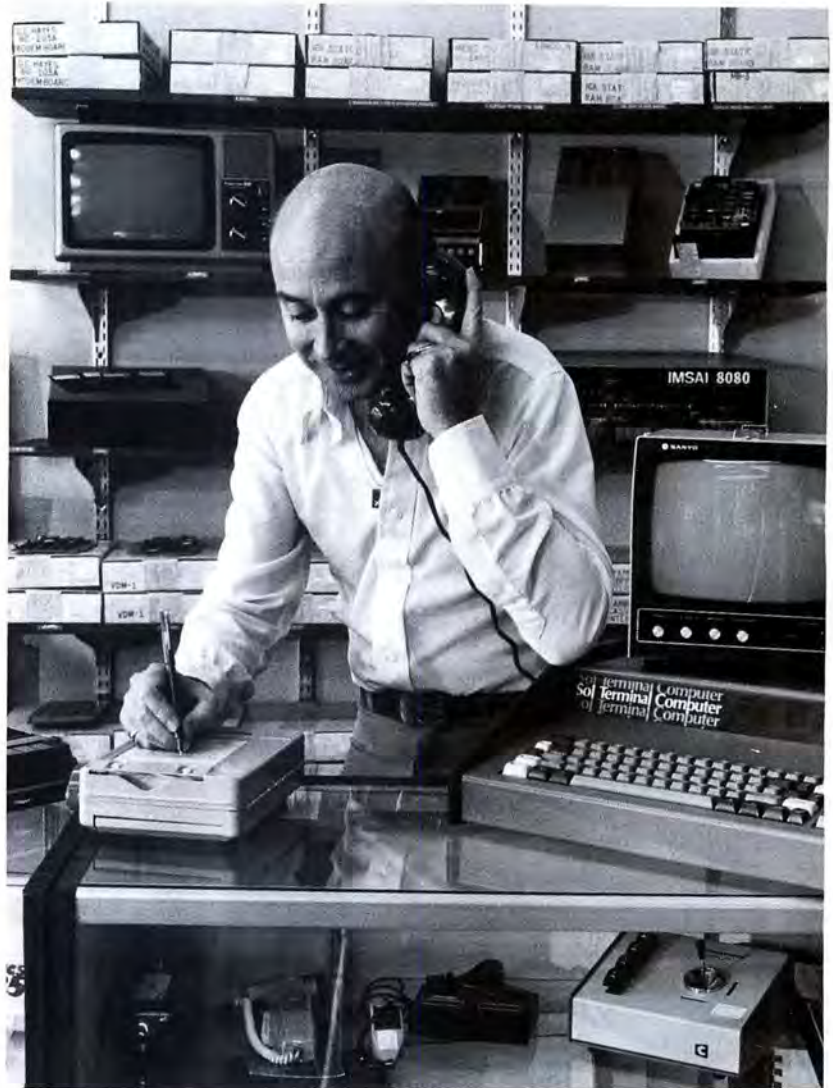
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on single occupant vehicles such as motorcycles and race cars.



Additional features of the system include a digital liquid crystal display; speed in MPH, time in seconds, distance in feet and engine RPM.

The basic system sells for \$4,995 with all necessary hardware and software for acceleration and braking tests. For further information contact Lamar Instruments, 1024 17th St., Hermosa Beach, CA 90254, (213) 374-1673.

CIRCLE INQUIRY NO. 126

### RD-11A and RD-11B Systems

RD-11A Computer System is an LSI-11 CPU System configured from a nine quad slot backplane (Digital Equipment Corp. DDV11-B). An additional nine dual width slots, unbussed, are provided. Adequate power is provided for a full expansion of the backplane.



The RD-11A is housed in a Digital Equipment Corporation H909-C enclosure modified to accept the system power supply, control logic and front panel switches and indicators. While the enclosure is designed to be rack mounted, it may also be used as a desktop unit.

RD-11B Computer System is an LSI-11 CPU system that utilizes an eight quad slot backplane. The system is housed in an enclosure that is suitable for either rack mounting or table top operation.

For more information contact RDA, Inc., 5012 Herzel Pl., Beltsville, MD 20705, (301) 937-2215.

CIRCLE INQUIRY NO. 122

### MITS 300

Pertec Computer Corporation's Microsystems Division has introduced a microcomputer-based integrated business system, the MITS 300.



Available in two configurations, the MITS 300 is a complete hardware and software system. The two configurations, a hard-disk system (the MITS 300/55) priced at \$15,950 and a floppy disk system (MITS 300/25) priced from \$11,450, provide capabilities for word processing, inventory control and accounting functions including general ledger, accounts pay-

able, accounts receivable and payroll.

The single-terminal MITS 300 is being marketed through more than 40 MITS Computer Centers across the country and on an OEM basis directly by the company. For more information contact Pertec Computer Corp., Microsystems Div., 21111 Erwin St., Woodland Hills, CA 91367, (213) 999-2020.

CIRCLE INQUIRY NO. 125

### New Microcomputer

Labtest Equipment Company has available their Model 300 Microcomputer as a new product for the industrial small computer market. Designed around the Intel 8080 microprocessor CPU, it is offered specifically for use in dedicated systems, control, and other industrial applications requiring a very reliable computer.



Unique in design concept, it has no front panel switches, it is completely self-contained in a rugged all metal RFI enclosure, includes extensive RFI and noise filtering, comes completely assembled and tested with 10K memory, one I/O board, power panel, cables and connectors, 2 fans, power supply, I/O ports, and a 22 slot motherboard. It operates with TTY or CRT and keyboard options.

The Model 300 is competitively priced. Delivery is 15 days ARO. For additional information contact Labtest Equipment Co., 11828 La Grange Ave., Los Angeles, CA 90025, (213) 478-2518.

CIRCLE INQUIRY NO. 120

### Attache™

A compact desktop computer that is more powerful, flexible and reliable than comparable models is available from Pertec Computer Corporation's Microsystems Division.

Called the Attache™, the 25-lb. unit is available through more than 40 MITS® dealers across the nation.



Built around the 8080 MPU, the Attache comes in a stylish cameo white case with full ASCII keyboard (upper and lower case). Its circuitry uses the S-100 bus configuration with a 10-slot board capability.

Provided in the basic configuration are keyboard, CPU board, video board, and turnkey monitor board. This basic configuration retails for \$1,449 assembled and tested. For more information contact Pertec Computer Corp., Microsystems Div., 21111 Erwin St., Woodland Hills, CA 91367, (213) 999-2020.

CIRCLE INQUIRY NO. 124

### Personal Computer with Program Library

The first home computer with a preprogrammed library of educational, home management and entertainment programs is available from Umtech.



Called "VideoBrain," this new personal computer is considered a third generation product because it does not require computer programming skill to implement sophisticated computer tasks as did the earlier generations.

The VideoBrain will be sold through department stores and specialty electronic stores. It already has FCC approval, and will sell at a suggested retail price of \$500.

The computer comes with everything necessary to hook it up to a TV and start running programs. For further information contact Umtech, 150 So. Wolfe Rd., Sunnyvale, CA 94086, (408) 737-2680.

CIRCLE INQUIRY NO. 121

### RD-11C Computer System

The size and weight advantages of large scale integration (LSI) technology and new micro-floppy mass memories are combined in a compact, general purpose computer system. Occupying one cubic foot, the RD-11C is a powerful stand alone computer system.

Based on the Digital Equipment Corporation LSI-11 CPU, the RD-11C is teamed with an integrally mounted, dual micro-floppy subsystem with 205K bytes of storage.



The unit is fully compatible with Digital's RT-11 Foreground/Background Operating System and supports a Macro-Assembler, Fortran IV, Multi-User Basic, APL, Focal, Forth, Pascal, SAL 11, and MINBOL programming languages.

An RD-11C with 8K bytes of RAM, dual micro-floppies and a serial console interface is \$4,595. A representative system with 40K bytes of memory, 2 serial interfaces, dual micro-floppies, and RT-11 with the ASR communications emulator is priced at \$7,975. Delivery is 30 days ARO. For additional information contact RDA, Inc., 5012 Herzel Pl., Beltsville, MD 20705, (301) 937-2215.

CIRCLE INQUIRY NO. 123

### 32-Bit Computer System

Digital Equipment Corporation introduced a new 32-bit computer system which combines the full power and performance of conven-



tional large mainframes with the interactive strength, flexibility and low cost of a mini-computer.



Called the interactive VAX-11/780, the new multi-user system is an extension of Digital's PDP-11 family and is priced below \$200,000. It features a new virtual memory operating system (VAX/VMS) which provides multi-users a direct addressing capability of over four billion bytes!

Prices for the VAX-11/780 system start at \$130,000 for a minimum configuration. Deliveries are scheduled to begin early this year. For more information contact Digital Equipment Corporation Maynard, MA 01754, (617) 897-5111, ext. 3046.

CIRCLE INQUIRY NO. 118

### Checker Challenger®

Fidelity Electronics, Ltd. brings a new dimension of excitement and suspense to the famous game of checkers . . . CHECKER CHALLENGER®.

Checker Challenger® is a computerized checker game in a solid walnut case, 12 1/2 x 8 x 1 1/2 inches high, which incorporates a sophisticated, reliable decision-making microprocessor as its brain. This microcomputer's high-level of thinking ability enables it to respond with its best possible counter moves, just like a skilled human opponent.



Checker Challenger® . . . the checker game that challenges you . . . invites you to sharpen your skills, improve your game . . . and learn and play whenever you want . . . always a willing and most worthy opponent. For literature and pricing information contact Fidelity Electronics, Ltd., 5245 W. Diversey Ave., Chicago, IL 60639, (312) 237-8090.

CIRCLE INQUIRY NO. 119

## Peripherals

### Music for SWTPC Owners

The Newtech Model 68 Music Board enables the user to generate music, sound effects, rhythms, Morse code, and touch-tone synthesis.

The Model 68 Music Board comes fully assembled and tested. It consists of a digital-to-analog converter, audio amplifier, speaker, volume control and phono jack for convenient connection to an external speaker or home audio system.



A complete Users Manual is supplied with the Model 68. It includes sound effect programs, test routines, and listing of a BASIC program for writing musical scores and a 6800 Assembly Language routine for playing them.

The Model 68 Music Board is \$59.95 through computer stores. For further information contact Newtech Computer Systems, Inc., 131 Joralemon St., Brooklyn, NY 11201.

CIRCLE INQUIRY NO. 147

### The Electric Pencil

The Electric Pencil is a character oriented word processing system. This means that text is entered as a continuous string of characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since lines are not delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. The typing of carriage returns as well as word hyphenation is not required since each line of text is formatted auto-

matically. As text is typed in and the end of a screen line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display screen as it occurs which eliminates any guesswork. Text may be reviewed at will by variable speed scrolling both in the forward and reverse directions.

When text is printed, The Electric Pencil automatically inserts carriage returns where they are needed. Character spacing and bi-directional printing are included in the Diablo versions. Right justification gives right-hand margins that are even. Pages may be numbered as well as titled.

Available on cassette or diskette (add \$25.00 for disk version) in various configurations. For mail order or information, contact Michael Shroyer, 3901 Los Feliz Blvd., #210, Los Angeles, CA 90027, (213) 665-7756.

CIRCLE INQUIRY NO. 144

## 2nd ANNIVERSARY SALE! February & March Only!

With each purchase of the following systems you will receive FREE a Panasonic 9" Video Monitor — ABSOLUTELY FREE! A value of \$175.00. Here are the systems to choose from:

### PROCESSOR TECHNOLOGY

Sol 20/ 8K factory tested and assembled for \$1850.00

### PROCESSOR TECHNOLOGY

Sol 20/16K factory tested and assembled for \$1975.00

Also available to you this month are 8K static memory boards that have been factory assembled-tested-and GUARANTEED for only \$200.00. Manufactured by Industrial Microsystems.

(212) 686-7923

— Stan Velt, Storekeeper

### COMPUTER MART OF NEW YORK INC.

118 Madison Ave. (Enter on 30th St.), New York, NY 10016

Open Tuesday to Saturday 9:30 a.m.-6:30 p.m.

By Mail, Phone, or In Person  
The Computer Mart of New York is the most reliable!



### MICROCOMPUTERS

### PERIPHERALS

### ACCESSORIES

CIRCLE INQUIRY NO. 65



### T-80 Thermal Printer

The new Model T-80 uses a non-impact, single thermal dot matrix printing head to offer a print speed of 80 characters per second.



The T-80 will be priced under \$1,000 in OEM quantities for the full receive-only printer and under \$600 for the printer mechanism only.

The printer is ideal for applications where only one copy is needed, where quiet operation is a necessity and where more expensive printer capabilities are not needed.

For more information contact Dataproducts Corp., 6219 DeSoto Ave., Woodland Hills, CA 91365, (213) 887-8451.

CIRCLE INQUIRY NO. 170

### Tape Drive

General Micro-Systems' new tape drive subsystem is a fast, inexpensive, high capacity data storage unit for use with microcomputers.

The drive is designed for unattended operation: all commands are computer driven. The full subsystem can copy data, sort files, update files, copy a full disk for backup storage, all from the computer program, without operator intervention.

The design is modular. The printed circuit boards, front panel and tape decks plug in and can be changed in minutes. All components except transformers and switches are on one

P.C. board.

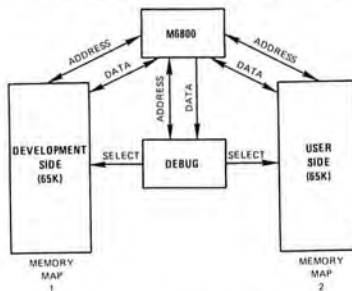
The circuit has been designed for absolutely no adjustments. There is nothing to get out of alignment. The read circuit is completely independent during a read operation.

For more information contact General Micro-Systems, 12369 W. Alabama Pl., Lakewood, CO 80228, (303) 985-3423.

CIRCLE INQUIRY NO. 175

### EXORciser II Emulator for M6800 Based Systems

EXORciser II, an improved version of Motorola's EXORciser, incorporates a new set of support modules intended for application as tools for design and development of hardware and software in M6800 microcomputer systems.



EXORciser II System Memory Map

The EXORciser II system and associated modules are designed to operate at clock speed up to 2.0 MHz, supporting the 68, 68A, and 68B series of chips produced by the Motorola NMOS Microcomponents Group.

In order to provide additional user flexibility, appropriate EXORciser II modules have a 20-pin connector for implementation of such system capabilities as priority interrupts, multi-page memory and I/O systems, and more.

For details contact Motorola Semiconductor

Products, 5005 E. McDowell Rd., Phoenix, AZ 85008, (602) 244-6900.

CIRCLE INQUIRY NO. 148

### M-200 Impact Matrix Printer

The M-200 is a new low-speed printer which combines the low-cost and flexible operation of a matrix printer with the most desirable features of a line printer.



The unit uses a dual-column 7x7 half-dot matrix font and a logic-seeking, lookahead feature to achieve a print speed of 320 characters per second in a bidirectional print mode. This provides work throughputs ranging from 125 lines per minute with a full 132-character line to as many as 300 lines per minute with shorter 40-character lines. Average throughput is 200 lines per minute.

The M-200 is designed for OEM use and will be available for deliveries beginning in the second quarter of 1978. It will be priced under \$2,000 in OEM quantities.

For more information contact Dataproducts Corp., 6219 DeSoto Ave., Woodland Hills, CA 91364, (213) 887-8000.

CIRCLE INQUIRY NO. 171

### Essential Accoutrements

#### TEXAS INST Lo Profile Sockets

Pin	1	10	100*
8	.30	2.50	20.00
14	.25	2.00	18.00
16	.27	2.20	20.00
18	.40	3.20	27.00
20	.80	6.00	40.00
22	50	4.00	30.00
24	50	4.00	30.00
28	50	4.00	30.00
40	50	4.00	30.00

\*Write for 1K  $\mu$ p pricing

#### Common DB Series Connector

	1	10	100*
DB 9P	1.10	1.00	.80
DB 9S	1.50	1.40	1.15
DB15P	1.50	1.40	1.15
DB15S	2.25	2.00	1.75
DB25P	2.25	2.00	1.80
DB25S	3.25	3.10	2.75
DC37P	2.95	2.75	2.50
DC37S	4.90	4.50	4.00
DD50P	3.90	3.50	3.25
DD50S	6.50	6.00	5.40

We stock a complete line  
of 7400, 74LS, 4000 CMOS

### FULL ASCII UPPER/LOWER CASE COMPUTER KEYBOARDS Used Guaranteed Working



Single Supply +5v @ 800 ma  
Schematics Included  
Basic Keyboard \$45.00  
Add: \$5.00 for Upper Case Alpha



\$5.00 Misc. Function Switch  
\$40.00 Metal Case w/bottom  
\$45.00 Metal with Walnut Ends  
\$1.50 Connector  
\$2.00 for 10 Extra Switches

### COMPUTER COMPONENTS

5848 Sepulveda Blvd., Van Nuys, CA 91411 (213) 786-7411  
4705 Artesia Blvd., Lawndale, CA 90260 (213) 370-4842

B of A and MC Welcome  
Terms: Min. order \$10.00  
add \$2.00 P and H if order is under  
\$25.00 and sent U.P.S.  
add \$4.00 P and H if sent via U.S. mail.

### Computers We Stock

IMSAI	699.
SOL20/8 Kit	1350.
Cromemco Z2	595.
Apple II (16K)	1698.
Poly 88	735.
Xitan I	769.
Vector Graphic	619.
Alpha Micro System	1495.
SOL20/16 Kit	1550.

### Memory Modules We Stock

SSM MB7 200ns 16K	525.
Industrial $\mu$ Systems 8K	229.
SPACEBYTE 16K Static	599.
Vector Graphic 250ns 8K	239.
SSM MB6 250ns 8K	188.
Industrial $\mu$ Systems 16K	525.
Quantronics 8K	225.

### DIP Switches

	1	10	100
4	1.85	1.65	1.45
5	1.85	1.65	1.45
6	1.85	1.65	1.45
7	2.00	1.80	1.60
8	2.20	1.90	1.70
9	2.30	2.10	1.75
10	2.40	2.20	1.80



### \$695 Microprinter with Serial Interface

The Microprinter-S1 with serial interface allows the user to select baud rates, parity and the number of stop bits.

Featuring a 7-bit serial RS-232 interface and standard ASCII 96 character set, the S1 operates at from 50 to 9600 baud and produces copy on aluminum coated paper by discharging an electric arc to penetrate the coating, which is less than one micron thick. Toners and ribbons are not required.



All S1's will come equipped with a 192-character first in-first out buffer and all will be factory set for 1200 baud (120 characters/sec.), no parity and one stop bit. Price is \$695. For more information contact Centronics Data Computer Corp., Hudson, NH 03051, (603) 883-0111.

CIRCLE INQUIRY NO. 172

### 2708 EPROM System

The Micro Words PROM System Board features 1K of high speed (350 ns), low power RAM and space for up to 8 2708 EPROMs, both DIP-switch addressable to start on any 8K boundary in memory. The exclusive I/O select feature allows the user to move the I/O locations to any unused 1K block in the EPROM memory space. This permits memory expansion to a full 56K of contiguous user RAM.

sion to a full 56K of contiguous user RAM.



The B-08 is a compact 2708 EPROM programmer that fits in a standard SWTPC 6800 I/O slot. A safety switch and LED indicator provide control over the high programming voltage generated on the board.

Prices for the PSB-08 are \$119.95 (EPROMs not included); PSB-08R \$124.95 (regulated + 12V); B-08, \$99.95; B-08R \$104.95 (regulated + 12V). For more information contact The Micro Works, P.O. Box 1110, Del Mar, CA 92014, (714) 756-2687.

CIRCLE INQUIRY NO. 174

### ADAC 1200 Acoustic Coupler

The ADAC 1200, with field proven reliability, transmits and receives data at 1200 bits per second (bps) either acoustically or over the dial up telephone network with a DAA. The ADAC 1200 is compatible with the Bell System 202C, DAA and EIA RS 232B/C devices. For convenience, two half duplex data channels are provided for simultaneous transmit/receive operations. The high speed channel transmits or receives data at 1200 bps while the low speed channel processes data at up to 5 bps.

A patented cup design made of flexible rubber allows different telephone handsets to be easily inserted, while providing both a positive mechanical connection and an acoustic field. The combination cup and sealed case provide over -40 dB isolation from sound interference.

For more information contact Anderson Jacobson, Inc., 521 Charcot Ave., San Jose, CA 95131, (408) 263-8520.

CIRCLE INQUIRY NO. 165

### Line Printer

The Malibu printer is a commercial grade dot matrix machine which operates bi-directionally at 165 characters per second and has graphics capabilities since each of the nine print-head wires is under software control.



An optional S-100 interface card is available which makes the printer immediately operable with many popular computers. An RS-232 option with a Z-80 on board allows the printer to accept serial input (up to 9600 baud) or parallel ASCII input with handshaking.

For further information contact Malibu Design Group, Inc., 211110G Nordhoff St., Chatsworth, CA 91311, (213) 998-7694.

CIRCLE INQUIRY NO. 177

# RONDURE COMPANY

2522 BUTLER ST. • DALLAS, TEXAS 75235 • 214-630-4621

## ASCII SELECTRIC



**TRENDATA 1000**  
Used working \$775.00  
Used working \$950.00  
(Factory refurb)

HARDWARE ASCII CODE CONVERSION (Parallel Receive Only) \$225.00  
(IBM Selectric Mechanism, Heavy Duty, Trendata Elect.)

### SPECIFICATIONS

Printer Mechanism: Heavy duty input/output, Series 745

Weight: Approximately 120 lbs.

Power: 115 volts ac  $\pm 10\%$ , 60Hz, 200 W.

Dimensions: 29"H x 35"W x 33"D

Temperature Range: 50°-110°F and a relative humidity of 50-80%

Print Speed: One line (14.8 characters) per second

Platen: 15" wide, pin feed or form feed device optional

Code Set: IBM 2741 compatible. Keyboard available in correspondence code

### Standard Features (no extra cost)

Electronic Features-single-board module, using integrated circuitry

Dial up. Reverse brake.

Attention feature and typewriter index

Typomatic keys (backspace, index, underscore and hyphen).

Attractive wood furniture workstation.

Operator control panel.

Reduced noise level, due to added sound deadening material.

the  
computer  
room



NOVATION  
DC3102A

USED  
WORKING  
\$150.00

RS232 Connection  
300 Baud



SHUGART MINI-FLOPPY DRIVE

NEW PRICE  
\$355.00 Each

MODEL  
SA-400

R7

### ORDERING INFORMATION:

All items subject to availability. Your money returned if we are out of stock. Items are either new (specified) or they are used (tested or untested) and no other warranty is made or implied.

In general no cords or cables are shipped unless we specify that they are supplied.

We ship the same day we receive a certified check or money order. Texas residents add 5% sales tax. Please call if you have a question.

Write for our CATALOG of many parts, terminals, printers, etc.

### SHIPPING INFORMATION:

Modems: \$2.00 each; 2 for \$4.00 UPS

Small Items & Parts: \$2.00/order less than \$20.00; \$4.00/order \$20.00 to \$100.00; \$6.00/order over \$100.00

Large Items & Parts: Specify Freight or Air Freight Collect

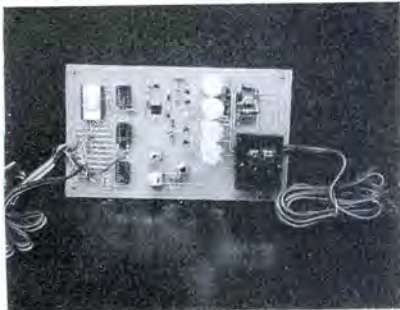
Foreign Orders: Add appropriate freight or postage. Please specify exactly what you wish by order number or name or both.

We now take Master Charge orders. Specify full number, bank number and expiration date.



## PROM Programmer

The EPB-2 PROM Programmer for 2704/2708 EPROMs uses software for its timing and control functions. It requires only 3 ICs, 6 transistors and power supply components to implement. All components including power supply fit on one 5"x8" PC board, which is epoxy glass, solder plated, double sided with plated thru holes.



Designed primarily for the SWTPC 6800, it can be easily adapted to I/O ports of other UP's. It interfaces to the SWTPC 6800 through one MP-L or MP-LA parallel I/O board.

The bare EPB-2 board, software and documentation is \$29. Add \$2.50 for S/H. (Doc. only \$5 PPD, refundable w/order). Ohio residents add 4% sales tax. For more information contact F&D Associates; 1210 Todd Rd., New Plymouth, OH 45654.

CIRCLE INQUIRY NO. 176

## Compact OEM Tape Transport

The Model 200 MINIDRIVE™ storage module is a low cost, super compact and highly reliable tape transport for the 3M Company's recently developed Model DC100A miniature Data Cartridge.



The transport, which forms the basic electro-mechanical building block for OEM data storage systems, measures only 3"x4"x4 1/4" with cartridge in place, weighs about 1 pound, and stores up to 720,000 bytes of unformatted data on the cartridge's 140 feet of magnetic tape.

The new Model MINIDRIVE™ is available in quantity within about 4 weeks from receipt of order. The associated electronic circuit boards have roughly the same delivery schedule. Prices range from \$250 to \$485, depending on configuration. For more details contact Qantex Div., North Atlantic Industries, Inc., 200 Terminal Dr., Plainview, NY 11803, (516) 681-8350.

CIRCLE INQUIRY NO. 159

## Impact Printer

The Integral Impact, model IP-120, is a low cost dot matrix impact printer capable of printing a full 80 to 132 columns on standard 8 1/2 inch wide paper, roll or fan-fold. A standard feature of this complete, ready-to-operate model is an integral RS-232 interface operating at switch selectable rates to 1200 baud.

Other standard features include enhanced (double-width) characters, current loop and parallel interfaces. This combination of low price and full printer features is attributed to a microprocessor based controller and a simple, yet rugged print mechanism.

The IP-120 is priced at \$745. OEM discounts start at quantity 2, and delivery is about 45

days ARO. For further information contact Integral Data Systems, Inc., 5 Bridge St., Watertown, MA 02172.

CIRCLE INQUIRY NO. 155

## Interface for Dura Mach 10 Terminals

Sirius Micro Systems has an interface for Dura/Intel Mach 10 or model 941 Selectric based terminals. Connection is to standard TTL parallel I/O ports and are therefore bus independent. This output only device will print using any code or style type ball.



Print control and code conversion are completely software controlled. This provides a minimum cost isolator to protect your computer from high terminal voltages.

Software driver example program is included for 8080/Z-80 based systems with flow chart and documentation for easy conversion to other computers or different type-balls.

For more information contact Sirius Micro Systems, 4490 Sirius Ave., Lompoc, CA 93436.

CIRCLE INQUIRY NO. 173

## MP-44 Miniprinter

The MP-44 Miniprinter is a simple and inexpensive 5x7 dot matrix printer for microcomputer systems. Electrosensitive paper is used to make permanent copies at speeds up to 88 characters per second with 44 characters per line. Software control allows expansion of character size for emphasis. Black characters are printed on aluminized paper 6 centimeters (2 1/4 inches) wide.



An enclosure houses the printer and paper supply mounted on an interface board with all necessary components for connection to any microcomputer with TTL logic levels. The microcomputer controls the motor and print electrodes by an 8-bit parallel output word, and senses timing signals on two input lines.

The price of the MP-44 Miniprinter is \$257 and is available from stock. For more information contact Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110, (714) 276-8911.

CIRCLE INQUIRY NO. 161

## Keyboard-Display

Amatech Instrumentation, Inc. has introduced a new microprocessor peripheral keyboard-display unit. Model 150-406, keyboard-display, interfaces very easily with most microprocessor systems (8080A, 6800, etc.). Features include a full hex, 8-digit display with viewing up to 20 feet, a 32-key keyboard with "N" key rollover and key debounce included in hardware.



Attractively packaged for either panel or desk mounting, this durable unit is particularly well-suited for process control and instrumentation applications. An 8080A microprocessor interface software package with schematic interface diagram is also available.

Send all inquiries to Amatech Instrumentation, Inc., 5 Marc Lane, Westport, CT 06880.

CIRCLE INQUIRY NO. 169

## COM-PRINT 400 Impact Printer

The Com-Print 400 is a compact table-top 40 column alphanumeric printer, ideally suited for hobby and small system needs.



The unit has a 75 line per minute printing capability with a peak printing rate in excess of 120 characters per second. Printing is by 5x7 dot matrix impact.

The universal printer controller is compatible with all computer and terminal systems having an 8-bit parallel interface. The Com-Print 400 can print the standard 64 ASCII character set and includes a full 40 character buffer memory. The unit prints on receipt of a carriage return or automatically whenever the line buffer memory is filled.

The Com-Print 400 is priced at \$349, complete with standard 3 1/2" wide paper roll and 4 million character life ribbon. Current delivery is from stock to two weeks. For more information contact Microcom Systems, 865 3rd St. So., St. Petersburg, FL 33701, (813) 823-0421.

CIRCLE INQUIRY NO. 164

## New Printer from DEC

The LX11 printer outputs 300 lines per minute for characters, and 170 lines per minute for plots. Designed to work with PDP-11 minicomputers, the LX11 can produce both double- and single-height characters in the full ASCII 96-character set, with or without underlining, under software control.





# ASSEMBLED SYSTEMS With Disk Capability AT KIT PRICES!

ISN'T YOUR TIME WORTH \$58.00?

Then why spend needless time and energy when we will deliver assembled and fully tested systems, like this one.

Ideal for the **BUSINESS OFFICE** or the **CLASSROOM**  
**North Star HORIZON**



North Star Horizon Single Drive System includes the Z-80 CPU at 2 or 4 MHz, motherboard, 16K of memory at 4 MHz and power supply. Software includes Disk Operating System and Disk BASIC. Horizon 1 kit is \$1599. Dual Drive Horizon is also available at \$1999.

We add monitor and keyboard.

**Compare our assembled prices and save  
hours of soldering, testing and trouble  
shooting!**

*Here is what  
you would pay  
if you bought  
these components  
as separate kits.*

#### OPTIONS

★ Move up to a Hazeltine 1500 CRT Terminal for an additional \$595.00.

Dual Drive \$395.00

Assembled systems sold with 90-day written warranty.

Come in and see our Horizon in operation.

#### Component

North Star HORIZON 1

Parallel Input/Output

PROM

Video Board (64 by 16) ★

9" Video Monitor

ASCII Keyboard and Enclosure

Your cost for separate kits would total \$2238.00.

**Your assembled price  
from Sunshine Com-  
puter Company is  
\$2296.00.**

#### SYSTEM SOFTWARE GIVES YOU TRUE DISK FILE CAPABILITY

You get the Horizon 1 complete with North Star Disk BASIC. Business software on diskette is also available with the purchase of your Horizon 1 for \$295, and includes:

- General Ledger
- Accounts Receivable
- Accounts Payable
- Payroll
- Inventory
- Amortization
- Mailing List

Each program is available for \$60 and all programs may be purchased separately for \$395.00.

## Sunshine Computer Company

20710 South Leapwood Ave. • Carson, California 90746 • (213) 327-2118



The plotting capability makes use of the PLXY-11M software package, a library of FORTRAN callable subroutines, supported by the RSK-11M operating system. Character and plot generation by impact permits multi-copy forms to be used with the LX11.

The LX11 is priced at \$14,400 including the PLXY-11M software package, and is available for delivery 90 days ARO. For more information contact Digital Equipment Corp., Maynard, MA 01754, (617) 493-2777.

CIRCLE INQUIRY NO. 163

### PP-2708/16 PROM Programmer

The PP-2708/16 PROM Programmer plugs directly into any 2708 or TMS-2716 memory socket. The PROM to be programmed is placed in the zero insertion force socket and the data is dumped over the 8 lower address lines using Oliver's proprietary interface.



Each unit comes complete with a DC to DC switching regulator, 10 turn ceramic trimmers for precise voltage and pulse width alignment, and a zero insertion force socket. The unit is packaged in a handsome black anodized aluminum case for table top operation. A 5-foot flat ribbon cable interconnects the programmer with the read only PROM socket via a 24-pin plug. Price for the kit is \$249.00; assembled, tested and aligned, \$295.00.

For additional information contact Oliver Advanced Engineering, Inc., 676 W. Wilson Ave., Glendale, CA 91203, (213) 240-0080.

CIRCLE INQUIRY NO. 140

### Programmer for Intersil's 6603 and 6604

The Model 66 programmer from PC/M has been designed specifically for programming the 6603 and 6604 devices. The devices from Intersil are 4096-bit programmable read-only memories (PROMs) which can be erased with ultra-violet light and re-programmed in the field or laboratory.



The programmer contains its own microprocessor and 4096-bit RAM buffer, and can be operated stand-alone from its own front panel or interactively with an ordinary CRT or TTY terminal through the programmer's RS-232 or 20 ma current-loop interfaces. The Model 66 can also communicate with a computer and/or automatic integrated-circuit test equipment for automated on-line PROM programming.

The Model 66 is priced at \$650, complete and ready for operation. Delivery is typically 30 days. For more information contact Pacific Cyber/Metrix, Inc., 3120 Crow Canyon Rd., San Ramon, CA 94583, (415) 837-5400.

CIRCLE INQUIRY NO. 141

### Z-80/8080 Minifloppy

A new Z-80/8080 minifloppy disk system from Vista Computer Company is priced \$50 less than competitive units, yet has the most powerful operating system available.



The Vista V80 provides fast-access, on-line storage economically for Z-80/8080 microcomputer users. System features include instantaneous program loading and dumping; efficient file management and storage; context editing of programs and text; dynamic debugging of programs; program assembly; batch processing; and a number of others.

The unit price of the Vista V80 Minifloppy Disk System is \$649 as a kit, or \$749 fully assembled and tested. For more details contact Vista Computer Co., 2807-FS Oregon Ct., Torrance, CA 90503, (213) 320-3880.

CIRCLE INQUIRY NO. 143

### Random Access Display

The DE/240 Intelligent Random Access Display has a 40 character/column, dot matrix vacuum fluorescent micro-display which features a full ASCII character set, and an on-board microprocessor which incorporates character generator, display buffer, refresh and control logic.



The display incorporates both parallel and serial (1200 Baud) interfaces, offering universal compatibility with bus oriented systems and with serial data devices.

Display evaluation kits (shipped with each initial order) include a data cable with connector, a power connector, and a complete User's Manual. Power supplies are available with either +5VDC or 110/120VAC input. The DE/240 is priced at \$273 in 100 quantity. For further information contact Digital Electronics Corp., 415 Peterson St., Oakland, CA 94601, (415) 532-2920.

CIRCLE INQUIRY NO. 156

### 1200 Baud Acoustic Coupler for \$795

The AJ 1245 will interface with any EIA terminal and communicate acoustically at 0 to 450 baud in 103 mode and 0 to 1200 baud in 202 mode. The user may switch select between these two modes with the coupler automatically adjusting baud rate and interface protocol. This new design can also automatically function as a "slave" unit to a remote 202 modem, and simultaneously provide a 103 full duplex interface to the terminal at speeds up to 1200 baud.

An innovative and easy to use new rubber cup design holds the handset firmly in place without the use of mechanical levers or springs.

With this new design, the acoustic cups are mounted vertically in order to provide optimum 1200 baud operation.

Normally in the acoustic mode, the 1245 automatically switches to the manual DAA modem when the DAA cable is connected. Both the receiver and transmitter of the AJ 1245 employ quartz crystal control for transmission accuracy and stability in the presence of variations in line voltage, temperature, data rate and receive signal.

The AJ 1245 carries a quantity one price of \$795. For further information contact Anderson Jacobson, 521 Charcot Ave., San Jose, CA 95131, (408) 263-8520.

CIRCLE INQUIRY NO. 167

### EPROM Programmer

A stand alone universal EPROM Programmer that is switch selectable between all the popular EPROMs; has HEX entry and display, comes in a small chassis, for under \$1000.



The 2716/2708 Model 3 Programmer handles 2716 — both single supply and triple supply, 2758, 2708 and 2704 devices.

The service version blank checks, programs, verifies, displays information in HEX and modifies data through hex keypad in up to 32 locations on any of the above devices. Price is \$995.

The software development version does all of the above plus TTY/RS 232 interface, tape reader/printer software, emulation of all the devices and 2K RAM buffer. Price is \$1295.

Production programming is done with a 16 gang machine based on the same board set. Simple, efficient, reliable. Price is \$2995. For more information contact PROM Programmers, Inc., 601 Nandell Ln., Los Altos, CA 94022, (415) 918-0450.

CIRCLE INQUIRY NO. 166

### New Data Splitter Kit

Terminal Data Corporation's popular Model 1200 RS-232 Data Splitter is available in kit form for those who want to save money and build their own interfaces.



The Model 1200 RS-232 Data Splitter gives a CRT Terminal user a second interface for a printer, plotter, cassette, or tape drive, at extremely low cost.

The kit consists of three RS-232-connectors, PC board, all necessary components, enclosure, mounting hardware, and assembly instructions. Assembly and test time is approximately four hours. Price is \$49.00. Available from many computer stores, or direct from Terminal Data Corp., 11878 Coakley Cir., Rockville, MD 20852, (301) 881-7655.

CIRCLE INQUIRY NO. 160



## Automatic Flatbed Drafting Plotter

The Data Technology 3454 Series Automatic Drafting Plotter is a medium-priced, flatbed plotter that operates at up to 16" per second, accurate to  $\pm 0.004$ " with a step size of 0.0025". For both on-line and off-line production, these plotters can interface to most digital data sources. A 34" x 54" flat work area can accommodate up to "E" size drawings.



The 3454 Series Plotters are equipped with a standard incremental interface, or optional RS232C interface. These flatbed systems use standard title paper, and the drafting surface is fully tiltable for better viewing while plotting.

The Data Technology 3454 Series Automatic Drafting Plotter prices begin at \$15,900 for a basic unit including plotter with drive, digital servo control, incremental input and 2-pen holder. For more information contact Data Technology, Inc., 4 Gill St., Woburn, MA 01801, (617) 935-8820.

CIRCLE INQUIRY NO. 157

## Peripheral Circuits Cover "Human Interface"

Intel Corporation's Microcomputer Components Division has introduced two "intelligent" devices that can operate almost any kind of

manual input and display output peripherals when given simple commands by an 8-bit microprocessor.



Named the Intel® 8275 Programmable CRT Controller and 8279 Programmable Keyboard/Display Interface, the new devices are the first peripheral circuits to cover the "human interface" needs of popular central processors such as the 8080A CPU, 8085 microprocessor and 8048 single-chip microcomputer.

For further information contact Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 248-8027.

CIRCLE INQUIRY NO. 154

## TH-1 Modem Kit

This easy to assembled modem kit features high quality at a low price. You will have a variable baud rate up to 300 baud. Complete documentation is included.

The price is \$49.95. Circuit board and documentation only for \$24.95. For more information or to order contact Astro Electronics Co., P.O. Box 1429, Alameda, CA 94501. California residents add sales tax when ordering.

CIRCLE INQUIRY NO. 162

## Performance Tape Transport

The Qantex Division of North Atlantic Indus-

tries, Inc., offers a new, rugged, compact commercial Model 650 tape transport for use with the 3M Company's DC300A Data Cartridge. The transport makes an OEM memory module capable of storing up to 23 megabits of unformatted digital data on the four tracks of a DC300A cartridge.



Model 650 embodies a number of distinguishing design features that particularly enhance its ability to handle vibration, impact, acceleration, and other forms of physical abuse that arise in "real world" applications.

Model 650 lists singly with operating electronics for \$920. The unit may also be purchased as a simple electromechanical transport for \$475, with servo/data card and control/housekeeping boards omitted. For more information contact Qantex Div., North Atlantic Industries, Inc., 200 Terminal Dr., Plainview, NY 11803, (516) 681-8350.

CIRCLE INQUIRY NO. 158





### Single 360/370 8-Channel Switch

Increased peripheral equipment utilization is provided by a new 8-channel switch that replaces two IBM 2914 (8x4) channel switches for 360, 370 and compatible systems. The BCS-4 (8x8) channel switch utilizes emitter coupled logic throughout for faster switching and is pre-wired for remote controlled operations.



The BCS-4 channel switch permits shifting of idle peripheral units to a computer channel which can actively utilize them. Critical on-line services can remain operational by providing paths to a back-up computer with the BCS-4.

For complete details contact John Beall & Co., Inc., 447 Gorge Rd., Cliffside Park, NJ 07010, (201) 945-1188.

CIRCLE INQUIRY NO. 153

### PUNCH

This device will exactly duplicate the punched holes on standard computer cards. Create your own, or correct mistakes. High grade solid steel, made to .001 of one inch tolerance. Instructions included, fully guaranteed. \$5.50 each. For more information contact PUNCH, P.O. Box 727, Stratford, CT 06497.

CIRCLE INQUIRY NO. 146

### Credit Card Verifier

The new Sheldon Credit Card Verifier, Model 1100, offers a 40-column dot matrix alpha/numeric printer for hardcopy audit trail and has an editing capability for selectivity in printing a data track as one continuous line or printing each field on that track as a separate line.



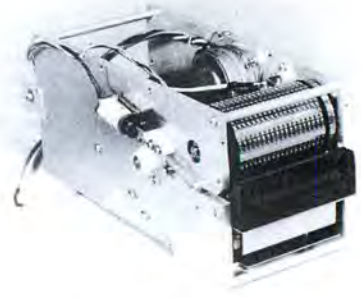
A choice of printing 40 single width characters per line or 20 double width characters for easier sight verification is provided.

The Model 1100 operates on 120VAC, in a temperature range of 0°C to 60°C. Prices range from \$1625 for one track to \$2025 for three tracks. For further information contact Sheldon Industries, Inc., 243 W. Maple Ave., Monrovia, CA 91016, (213) 358-2588.

CIRCLE INQUIRY NO. 145

### Impact Printer Mechanisms

Two drum-type, form printer mechanisms: FPM-600 Numeric, and FPM-700 Alphanumeric series, can print up to 19 columns either on standard medical forms (3.25 inches wide) or on forms of varying widths. A variety of standard, center-to-center line spacings and special configurations can be provided. Ribbon-type models are available for forms whose top copy does not use pressure-sensitive paper.



Printing rate for the FPM-600 series is 2.4 lps for 19 columns of 16 characters (10 numeric); for the FPM-700 series, 4 lps for 19 columns of 42 alphanumeric and symbol characters.

For further information contact Anadex, Inc., 9825 DeSoto Ave., Chatsworth, CA 91311, (213) 998-8010.

CIRCLE INQUIRY NO. 168

### Matrix Printers

The Lear-Siegler 200 series of bidirectional matrix printers includes the Model 201 matrix printer and the Model 210 receive-only communications terminal.



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- Micromation Disk System

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DIAL (305) 264-BYTE

BYTE SHOP OF FORT LAUDERDALE  
1044 E. Oakland Park Blvd., Ft. Lauderdale, FL 33334  
DIAL (305) 561-BYTE





Throughput capacity of both matrix printers has been increased to 75 lines per minute for 132 character lines; to 120 lines per minute for 80 character lines; and more than 900 lines per minute for 1 character lines.

The Model 201 will sell for \$2,895 (single quantity) and the Model 210 will sell for \$2,995 (single quantity). For further information contact Lear Siegler, Inc./EID Data Products, 714 N. Brookhurst St., Anaheim, CA 92803, (714) 774-1010.

CIRCLE INQUIRY NO. 151

### CIS-30+ Interfaces MITS 680b to Cassettes

The CIS-30+ provides user-selected cassette data rates of 30, 60, or 120 bytes per second, and data terminal rates of 300, 600, or 1200 baud.



The two cassette interfacing circuits are independent and operations such as cross filing therefore are possible. Optional program control of recorders is available.

Cassette data recording is KC-Standard/Bi-Phase-M (double frequency).

The CIS-30+ sells for \$79.95 in kit form and \$99.95 assembled and tested. An instruction manual is included. For MITS 680b applications, request Percom™ Tech Memo TM-CIS-30-9, "Using the Percom CIS-30+ with the MITS 680b Computer."

For information contact Percom Data Co., 318 Barnes, Garland, TX 75042, (214) 276-1968.

CIRCLE INQUIRY NO. 142

### Dumb Terminal™/Printer Peripheral Package

Lear Siegler, Inc./EID, Data Products has introduced its first CRT/Printer peripheral package. The package, which Lear Siegler calls the Dumb Connection™ Peripheral Package, includes the company's ADM-3A Dumb Terminal™, Model 210 Ballistic™ Printer, and interconnecting cable.



Priced at \$3890 (single quantity), the Dumb Connection gives the user the flexibility to have both a video display terminal and a 180 cps receive-only serial printer for about the same price as a comparable speed KSR printer.

Both the Dumb Terminal and Ballistic Printer are designed for asynchronous operation. For more information contact Lear Siegler, Inc./EID Data Products, 714 N. Brookhurst St., Anaheim, CA 92803, Attn: Marketing Communications Department.

CIRCLE INQUIRY NO. 150

### MK-II Interfaces Touch-Tone®

MK Enterprises has a Dual Tone Multi-Fre-

quency (DTMF) transceiver board which interfaces your S-100 microcomputer to the Touch-Tone® telephone. The board converts Bell System's DTMF into binary and binary into DTMF, making a fully operational Touch-Tone® transceiver.



The MK-II comes fully assembled and tested with applications information and manual for

\$425.00. Delivery takes from 4-6 weeks. For further information contact MK Enterprises, 8911 Norwick Rd., Richmond, VA 23229, (804) 285-2292.

\* Registered trademark of AT&T.

CIRCLE INQUIRY NO. 149

### Low-Power Cartridge Transport

A new second-generation 3M-type cartridge transport gives near one-half inch tape reliability along with a storage capacity for exceeding common cassette equipment.

Requiring only a dual-voltage power supply, the Model 631 dissipates a maximum 22.6 watts during start. When running, consumption drops to 8.2 watts.

The Model 631 is priced from \$500 to \$795 depending upon speed and the number of tracks specified. OEM quantity discounts are available. Delivery is 60 days ARO. For more information contact Kennedy Co., 540 W. Woodbury Rd., Altadena, CA 91001, (213) 798-0953.

CIRCLE INQUIRY NO. 152

## BUSINESS SYSTEMS from MISSION CONTROL SEE US PERCOMP '78 LONG BEACH, CA — APRIL 28-30

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- Soroc IQ 120
- Basic

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If you have software designed to run in either Apple II, North Star, Micropolis or Alpha Micro Basics and are interested in selling it, write for our guidelines on programming.

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**MISSION  
CONTROL**

CIRCLE INQUIRY NO. 72

INTERFACE AGE 121

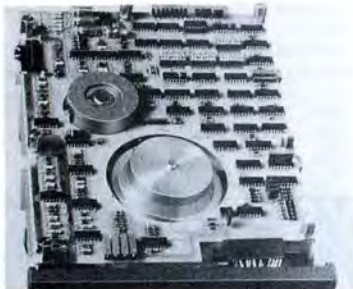


# Disks

## Flexible Disk Drive

MFE Corporation's new Flexible Disk Drive is a small (8.70"x4.35" x12"), double-sided, double-density unit employing a proprietary "Heli-Band"™ head positioning system.

The head carriage mechanism utilizes ceramic read-write heads and ceramic head load pads.



The Flexible Disk Drive is available with either a center mounted brushless DC spindle drive motor or a corner mounted AC motor.

Other basic features include: data transfer rates of 250K/500K bits per disk with a packing density of 3400/6800 bpi; 77 tracks per side at 48 tracks/inch.

For more details contact MFE Corp., Kee-  
waydin Dr., Salem, NH 03079, (603) 893-1921.

CIRCLE INQUIRY NO. 184

## Calcomp Floppy Disk System

California Computer Products, Inc. has a multifunction floppy disk system designed for

use with any processor having an RS-232-C communications port.



Offering a total storage capacity of 2.0 megabytes, the new system includes a single or dual floppy disk drives, power supply, cables and a microprocessor-driven controller that supports as many as four drives and up to two RS-232-C devices. Use of a microprocessor-driven controller makes possible a substantial reduction in requirements for host computer hardware and operating system software.

A system with two 143M drives is priced at \$3,630. For further information contact California Computer Products, Inc., 2411 W. La Palma Ave., Anaheim, CA 92801, (714) 821-2541.

CIRCLE INQUIRY NO. 188

## Remex-11 Flexible Disk System

Users of PDP-11 computers can improve the efficiency of their equipment by taking advantage of this flexible unit that connects directly to the PDP-11 Unibus.



Software modules of the Remex-11 system allow it to operate in an RT-11 environment, using either the standard DEC RX-01 26-sector format or a 16-sector format to increase the disk storage capacity by at least 25 percent.

Up to four flexible disk drives can be included in the Remex-11 installation. A single rack-mounted unit contains the controller/formatter circuitry for the complete system, a power supply, disk storage bin and space for two disk drives. A separate enclosure, with its own power supply and control panel, houses the third and fourth drives.

For further information contact Ex-Cell-O Corp., Remex Div., 1733 Alton St., P.O. Box C-19533, Irvine, CA 92713, (714) 557-6860.

CIRCLE INQUIRY NO. 187

## 10/80 Megabyte Disk Drive

R2E of America announces a new 10/80 megabyte disk system with removable media for its MICRAL C small business microcomputer system.

## RAM'S [STATIC]

2102AL-4	Nec 450NS	1.45
	64-99	1.40
	100-Up	1.35

2101AL-4	Nec 450NS	2.75
2111AL-4	Nec 450NS	2.75
6810-1	128x8 Bit	5.00
68B10	2MHZ RAM	12.00
Nec 410D	4Kx1	13.00

## SAMTEC SOCKETS LOW PROFILE DIPS

	1-99	100-Up
14 Pin	.20	.18
16 Pin	.22	.20
22 Pin	.35	.33
24 Pin	.33	.30
28 Pin	.42	.40
40 Pin	.45	.43

## IMSIA CONNECTORS S-100

1-25	3.50
25-Up	3.25

## ITHACA AUDIO BOARDS PARTS

8K Ram Card	25.00
Nec Ram Kit	89.50
Support Chip Set	12.50
Socket Set	17.20
Regulator Kit	8.00

## DOCUMENTATION AND MANUALS

INTEL 8080A User Manual	7.50
INTEL 8085 User Manual	5.00
Z-80 User Manual	6.50
8748 User Manual	5.00
8741 User Manual	5.00

Cosmac VIP Computer	\$275.00
Seal's 8K RAM Board	\$215.00
Seal's 4K RAM Board	\$160.00

Prototype Board	
Wire Wrap	\$20.00
Solder Pad	\$20.00
Extender Board	\$16.00

Sugart SA-400 Mini Floppy	
Disk Drive	\$325.00

Sanyo 9" Monitor	\$160.00
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8T97	1.40	8T98	1.40	8T26B	2.25
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340T-5	1.00	340T-12	1.00
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7805	1.00	7812	1.00
------	------	------	------

## YA-3-1014A/1015A \$9.00

Single supply 5 volts replaces all UARTS (pin for pin)

## DIP SWITCH

8 Switch 7 Switch

\$1.75 each

## EpROMS

2708		\$16.00
2716 Intel [5 Volt]		50.00
2758 [2708 5 Volt]		35.00
5204 512x8 Bit		14.00
1702A 256x4 Bit		4.50
6834 512x8 Bit		17.50
82S23 32x8 Bit		2.25

## MICROPROCESSORS

Z-80	Zilog CPU	24.00
8085	Intel 5 Volt CPU	
	[8080 with clock]	29.00
8080A	Nec 2 Mhz CPU	13.50
8080A-1	Nec 3 Mhz CPU	21.00
8080A-2	Nec 2.5 Mhz CPU	20.00
6800	Mot. CPU	24.00
8741	EpROM 8041	
	[UPI-41]	78.00
8748	EpROM 8048 MCP	70.00
6800	Mot. 2MHZ CPU	43.00
2650	Sig. CPU	30.00

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27.000 Mhz 6.144 Mhz (8085)

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OHM Meter \$49.95

## MICROPROCESSOR

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6821	P.I.A.	15.00
68B21	P.I.A. (2MHZ)	20.00
68B50	ACIA (2MHZ)	25.00
68488	IEEE-488 Interface	
	Chip	\$43.00
8253	Prog. Timer	26.00
8257	DMA Controller	29.00
8259	Interrupt Cont.	27.00
8275	CRT Cont.	100.00
8271	Floppy Disk Cont.	90.00
8279	Keyboard/Display	
	Cont.	23.00

MC1408 8 BIT D to A 6.50

MC1489A/EIA Receivers 2.50

MC1488 EIA Driver 2.50

Z-80 PIO (Parallel I/O) 13.00

Z-80 CTC (Timer) 14.00

8212 8 bit Latch 3.25

8224 8080A Clock Chip 4.50

8238 8080A Bus Driver 7.00

8251 Serial I/O 7.00

8255C Parallel I/O 7.00

8214 Interrupt Chip 10.00

8155 256x8 Ram, 22 I/O

Lines and Timer 23.00

8253 Prog. Interval Timer 27.50

8755-8 EpROM and I/O 185.00

6820 PIA 10.00

6850 ACIA 12.00

6852 Syn. ACIA 16.00

6860 Modem 12.00

2513 Upper Case ASC11 8.00

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The MICRAL C is the low cost, compact data processing system for small business applications such as accounting, word processing, and inventory management. The addition of the new disk provides a microcomputer system with tremendous storage capabilities (from 10 to 80 megabytes), at a low cost.

The end user price for the MICRAL C system with a 10 megabyte disk is \$15,950. Deliveries are 90 days ARO from the plant in Minneapolis. For further information contact R2E of America, 3406 University Ave., S.E., Minneapolis, MN 55414, (216) 562-9908.

CIRCLE INQUIRY NO. 179

### Low-Cost Disk Drive

The Series 5300 line of fixed-carriage, moving-head disk drives, from Kennedy Company stores up to 70M bytes of data at rates of 1M byte per second.

Head positioning is controlled by prerecorded servo-tracks on the bottom of one disk, eliminating mechanical encoder plates.



The drives measure 19" wide by 7" high by 22" deep (48.26cm x 17.78cm x 55.88cm). Weight is 45 lbs. (20.41kg).

Series 5300 prices range from \$2500 to \$4000 depending on capacity and quantity ordered. Delivery is 90 days ARO. For more information contact Kennedy Co., 540 W. Woodbury Rd., Altadena, CA 91001, (213) 798-0953.

CIRCLE INQUIRY NO. 185

### Mostek's Floppy Disk

A new microcomputer system with powerful software, Z80 power, and floppy disk versatility is called AID-80-F. It is a complete disk-based computer that provides all the tools required for hardware/software development and debug.



The heart of the AID-80F is the SDB™-80 which provides the power of the Z80 microcomputer plus 16K bytes of on-board RAM. The memory and I/O expansion board RAM-80 includes 16Kbytes of RAM and four

8-bit I/O ports. The flexible disk-drive controller board FLP-80 interfaces the SDB-80 with up to four drives with soft sector format.

The AID-80F is priced at just \$5995 and each board is also available separately. For more information contact Mostek Corp., 1215 West Crosby Rd., Carrollton, TX 75006, (214) 242-0444.

CIRCLE INQUIRY NO. 181

### Minifloppy® Disk Storage System

The LFD-400 is a minifloppy® disk memory system for the SS-50 bus. A complete 1-drive LFD-400 system includes a controller PC board, PROMware disk operating system, disk drive and drive power supply, interconnecting cable, two minidiskettes®, an operator's manual, and a compact enclosure to house the drive and drive power supply.



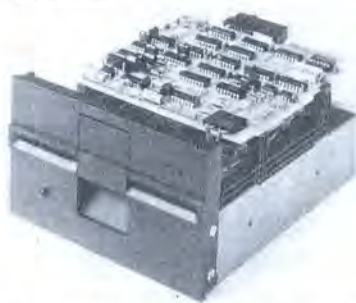
The controller board, which is installed in an SS-50 bus slot of the host computer, includes special low-voltage-drop regulators, a proprietary "bit shifting" compensation circuit, an inactivity time-out circuit to increase drive motor life, and provision for 3K byte of PROM.

For more information contact PerCom Data Co., Inc., 318 Barnes, Garland, TX 75042, (214) 276-1968.

CIRCLE INQUIRY NO. 180

### Shugart Double-Sided, Double-Density Floppy Disk Drive

The SA450 double-sided/double-density/double-headed minifloppy® disk drive offers OEMs up to 440 kbytes of unformatted data storage on-line.



The new double-sided drive reads and writes data on both sides of a minidiskette™ without removing it from the drive. The twin read/write heads are Shugart's proprietary glass bonded ferrite ceramic heads, which are mounted in a stainless steel flexure that loads onto the minidiskette when in operation.

Price of the SA450 in quantity one is \$450. OEM discounts are available. Delivery is 90 days ARO. For more information contact Shugart Associates, 415 Oakmead Pkwy., Sunnyvale, CA 94086, (408) 733-0100.

CIRCLE INQUIRY NO. 183

### INFO 2000 Disk System

Now Heathkit H8 users may easily add the complete INFO 2000 Disk System and simultaneously upgrade their 8080 computer to a Z80 system by replacing the Heathkit 8080 CPU board with the INFO 2000 Z80/Disk Adapter Board.



All INFO 2000 Disk Systems are assembled and tested at the factory, and are provided with a 90-day warranty. Delivery time is 3-4 weeks ARO. A 5% discount is offered when payment in full accompanies orders. Dealer inquiries are welcome. Cost for the complete INFO 2000 Disk System for Heathkit H8 is \$2,750. For more information contact INFO 2000 Corp., 20630 S. Leapwood Ave., Carson, CA 90746, (213) 532-1702.

CIRCLE INQUIRY NO. 182

### Remex RFS 1100 Flexible Disk Drive

The new Remex flexible disk drive eliminates the need for a separate formatter/controller. All formatting, control and read/write circuits plus optional 128 or 256-byte sector data buffers are mounted on a single printed circuit board contained within the 4.5x9.0x14.1-inch disk drive envelope.



With the control circuitry incorporated within the drive, the Remex RFS 1100 drive becomes a highly compact unit, occupying a minimum of space and providing the system designer with a new level of flexibility. The drive can be mounted upright, on either side, or with the cover at the top.

For information contact Remex Div., Ex-Cell-O Corp., 1733 Alton St., P.O. Box C-19533, Irvine, CA 92713, (714) 557-6860.

CIRCLE INQUIRY NO. 186

### New Four-Headed Voice Coil Floppy

The "four-headed" flexible disk drive will store up to 3.2 Mbytes of data in the space required by a standard size floppy drive. The new PerSci Model 299 Diskette Drive, interfacing to 8080, 6800 and Z-80 based systems as well as minicomputers, provides the basis for a low cost, independent data management system.

The Model 299 is a dual-headed, dual diskette drive reading and writing both sides of two 8" diskettes. Data can be encoded in single or double density in IBM compatible soft sector formats or expanded hard and soft sector formats on IBM Diskette I, II, IID or equivalent media. The drive will store up to 1 Mbyte of data in IBM format, 1.6 Mbytes unformatted single density and up to 3.2 Mbytes in unformatted double density encoding.

The Model 299 is priced at \$1,595 in single unit quantity. Delivery is second quarter 1978. For more information contact PerSci, Inc., 12210 Nebraska Ave., W. Los Angeles, CA 90025, (213) 820-3764.

CIRCLE INQUIRY NO. 178



# Terminals

## IBM Selectric Printer Approved for Microcomputer Output

The SELECTERM may be connected directly to either parallel or serial port, with all inputs at standard TTL level. No additional software is required since all logic is in an internal PROM. The SelectTerm includes a special typing element that produces all ASCII and full upper and lower case alphanumeric characters. Also included are a tab command, backspace, vertical tab and bell. All necessary electronics and cable sets are provided along with documentation for unpacking, connection, testing, theory of operation and schematics.



The SelectTerm may be purchased only through dealers, though OEM inquiries are invited. Full price is \$16.50. For more information contact your computer store dealer or Micro Computer Devices, Inc., 960 E. Orangethorpe, Bldg. F, Anaheim, CA 92801, (714) 992-2270.

CIRCLE INQUIRY NO. 194

## Voice-Input Automatic Paging Terminal

The Dialog 810 Terminal is an end-to-end signaling decoder that allows page-number entry by a caller speaking the digits directly to the terminal over telephone lines with no operator interface.

The terminal, which provides completely automatic end-to-end signaling, handles up to eight telephone lines simultaneously. It can be used in tone and voice as well as tone-only paging. The 810 Terminal can also be equipped with a Touch-Tone input option along with the voice recognition capability.

The terminal allows data communication with the standard RS-232, asynchronous full duplex up to 4800 baud or 20MA serial current loop (Teletype). Special optional parallel interfaces can also be provided.

The price of a standard 810 Terminal is \$70,000. For more information contact Dialog Systems, Inc., 32 Locust St., Belmont, MA 02178, (617) 489-2830.

CIRCLE INQUIRY NO. 198

## Universal Keyboard UKB-1

This 63 key Universal Keyboard will generate any specified code in serial/parallel formats at selectable baud rates. Custom legends are provided for each key top.



High impact plastic keyboard featuring quadruply redundant switches is housed in a 1/8 inch aluminum enclosure (17.8x3.7x9.5 inches). Standard keyboards for generating ASCII, BAUDOT and MORSE CODES are stock items. Unit prices are from \$299.

For more information contact Microlog Corp., 4 Professional Dr., Suite 119, Gaithersburg, MD 20760, (301) 948-5200.

CIRCLE INQUIRY NO. 200

## Motorola EPIC 68 Intelligent Terminal

The EPIC 68 is a multifunction, display-oriented microcomputer/terminal. Through its highly modular hardware, software and packaging, Epic 68 provides a wide range application vehicle from a passive, but intelligent information monitor, up to a complete, stand-alone, information processing system.



This versatility is achieved with a 6800 based system controller that provides for serial asynchronous communications, various levels of display function, a keyboard interface with six

optional configurations, and packaging provisions allowing internal addition of up to eight micromodule cards.

A typical configuration, including a basic display unit, extended communications and display features and keyboard with cable sells for \$2690. For more information contact Motorola Semiconductor Products, Inc., 5005 E. McDowell Rd., Phoenix, AZ 85008, (602) 244-6900.

CIRCLE INQUIRY NO. 192

## 120 CPS Printer/Terminal

The SuperTerm data terminal makes use of microprocessor control. This new SuperTerm includes such standard features as an RS-232C interface, current loop interface, an IBM selectric configured keyboard with a numeric keypad, 132 column width printing, horizontal tabs, vertical tabs, top of form, and a keyboard lock-out feature.



The basic terminal prints at speeds up to 60 cps with a 120 cps option presently available. Printing is performed by Intertec's newly de-

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IMSAI 8080  
BYTE-8  
SWTP MP68  
CROMEMCO  
PROCESSOR TECH

MEMORY EXPANSION  
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signed impact matrix printhead which is fully guaranteed for one year. Prices start at \$1995.

The unit is a portable desk top version which can be used with or without the stand. For more information or a complete catalog contact Intertec Data Systems Corp., 19530 Club House Rd., Gaithersburg, MD 20760, (301) 948-2400.

CIRCLE INQUIRY NO. 196

### Transactor Terminal

The Transactor III Data Terminal utilizes a microprocessor in its design to provide many features associated with higher cost terminals. Features available include synchronous or asynchronous communications line support for both dedicated or polled multidrop environments.



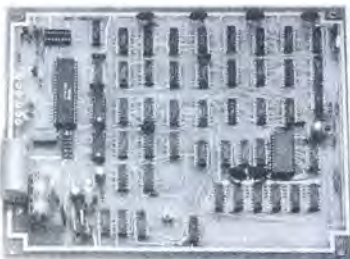
The Transactor III data terminal includes a single line 32 character gas discharge display and a 53 key TTY style keyboard. It can be directly attached to any computer with an RS-232 or 20 mA current loop interface, or can be attached to a communications line through a modem.

The standard terminal is available from stock for \$995.00 in singles. For more information contact Computerwise, Inc., 4006 E. 137th Ter., Grandview, MO 64030, (816) 765-3330.

CIRCLE INQUIRY NO. 190

### Video Terminal Board (VTB)

Micro-Term, Inc., offers the complete logic circuitry of the versatile ACT-1A CRT terminal on a single 8"x10 1/2" printed circuit board. The VTB includes a power transformer, voltage regulator and on-board power supply. Addition of a parallel ASCII keyboard with positive logic outputs and a CRT monitor results in a complete stand-alone computer terminal capable of communicating with any serial ASCII computer.



The VTB's standard features include 64x16 display of upper and lower case descending characters, cursor control, bell, switch selectable, crystal-controlled data rates from 100 to 19,200 baud, RS232C interface, switch selectable UART options and an on-board power supply capable of satisfying the power requirements of several popular ASCII keyboards.

The VTB is priced at \$200. For more information contact Micro-Term, Inc., P.O. Box 9387, St. Louis, MO 63117, (314) 645-3656.

CIRCLE INQUIRY NO. 203

### Mobile Data Communication Terminal

Cassetterm II, second generation of the Cassetterm, has more added convenience features to broaden the usefulness of the unit, but basically the functional integrity, portability and operating features remain the same. These include a minicassette memory system for serial storage and read-out of up to 40,000 alpha numeric characters per cassette at 110 or 300 baud rates, universal acoustic coupler that accepts a telephone handset, a 32-character display panel and full ASCII compatibility.



The basic unit is being marketed for \$1995 on a single quantity basis. The Cassetterm II can be ordered in eight colors and is fully warranted for one year. For additional information contact Micon Industries, 252 Oak St., Oakland, CA 94607, (415) 763-6033.

CIRCLE INQUIRY NO. 195

### Mid-Range Systems for Word Processing

A new series of expandable, multi-terminal word processing systems, designated the WS200 series, are multi-station, PDP-8-based systems. They provide mid-range offerings between the WS78 single-user, stand-alone systems and larger PDP-11-based, shared logic configurations.



The WS202, basic system of the series, includes two text editing terminals, DEC's letter quality printer, word processing computer, four flexible diskettes in a four-foot-high cabinet and communications software.

List price for the basic system is \$27,995. For more information contact Digital Equipment Corp., Maynard, MA 01754, (603) 883-8000, Ext. 179.

CIRCLE INQUIRY NO. 191

### Viewport

Viewport is a complete TV text display hardware/software system for your personal or business microcomputer. The entire package comes on a single S-100 bus compatible high quality printed circuit board, with onboard software. Plug it into your system, connect the coaxial cable to a 10mhz or better TV monitor, and you're in business.

FLASH (wnum) causes window WNUM to be flashed once (the figure-ground of the window's interior is momentarily reversed).

PLOT (wnum,x,y,char) writes CHAR to window WNUM at point X,Y (relative to the window). This permits plotting, drawing, etc. without the risk of invoking the scrolling or rolling mechanism.

BACK (wnum,n) causes N blank lines to be written to window WNUM, but moving up from the current line. Except for this difference in direction, and for the fact that BACK cannot cause rolling or scrolling, BACK is similar to SKIP. BACK is useful for such things as displaying system stacks (pushing and popping) as they change during run time.

Viewport is available in kit form, complete with all the CRT logic, 4K static display memory, and 1K onboard software (including other user-callable functions not described). You get the whole package with a comprehensive theory of operation manual, assembly instructions, suggested applications, and warranty for \$295. When ordering, be sure to specify the 8K boundary at which you want the onboard software to be located (we will supply the software assembled to run at any 8K boundary), and which character set you want (graphics, or math/logical/text editing).

For more information contact Micro Diversions, Inc., P.O. Box 527, Falls Church, VA 22046, (703) 533-1133.

CIRCLE INQUIRY NO. 201

### Naked Terminal

The Naked Terminal displays 80 characters by 24 lines, using both upper and lower case characters in a 5x7 font.

Editing is aided by an addressable cursor.

Switch-selectable features include black-on-white or white-on-black, blinking or non-blinking underline cursor, and variable baud rates.

The Naked Terminal is a complete dumb terminal on an S-100 board. It contains a microprocessor with its own memory, its own software drivers, and its own internal bus. It won't take up any of the 64K memory address space of the S-100 bus.

For additional information contact Dynabyte, Inc., 4020 Fabian, Palo Alto, CA 94303, (415) 494-7817.

CIRCLE INQUIRY NO. 189

### General Purpose Remote Terminal

The TIGER (Television Interface General-purpose Economy Remote terminal) contains an acoustic coupler for communications with remote time share computers, full ASCII keyboard, and television electronics that provide interconnection to a standard TV set via the antenna input. Up to 1024 characters may be simultaneously displayed in switch selectable formats for 8 or 16 lines of 32 or 64 characters.



The unit has a built-in power supply, measures 8"x10"x3" and weighs only 4 pounds. Additional features include eight selectable baud rates from 110 to 9600, complete TTY compatibility, built-in RS-232C connector for direct hookup to a computer, and more.

The TIGER terminal sells for \$500. For more information contact Micon Industries, 252 Oak St., Oakland, CA 94607, (415) 763-6033.

CIRCLE INQUIRY NO. 193

### Telephone Data Collection Terminal

Model 600BX is an intelligent, microprocessor-based Individual Circuit Usage and Peg Count (ICUP) data collection terminal. With a capacity of up to 16,000 inputs per terminal, it is designed for medium and large-size telephone company central offices.



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Byte Publications, Inc.	Integrand Research Corp.	Quay Corp.
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California Business Machines	International Data Systems, Inc.	SD Sales Co.
Camelot Publishing Co.	Ithaca Audio	Smoke Signal Broadcasting
Cherry Electrical Products Corp.	Jade Co.	Solid State Music
CMC Marketing Corp.	Micromation, Inc.	Southwest Technical Products Corp.
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600BX terminals collect ICUP data from telco central office trunks and switching items and process this data.



The 600BX terminal is available in two versions for use in either a distributed processing or centralized processing system configuration. The first, 600BX-ALPHA, is a centralized processing configuration used with the Alston "ATEMIS" minicomputer data center. The second version, 600BX-BETA, is an intelligent terminal. It is typically used in a distributed processing system.

Both versions of the 600BX terminal have immediate availability. For more information or a free brochure contact Conrac Corp., Alston Div., 1724 So. Mountain Ave., Duarte, CA 91010, (213) 367-1211.

CIRCLE INQUIRY NO. 202

## Abacus Computer

Abacus Computer Systems has a low-cost, portable computer terminal that is suitable for microcomputers, computer evaluation kits, data entry systems and time sharing systems. The printer uses paper similar to a ticker tape machine.



The terminal is TTY compatible or it can be connected directly to the computer serial I/O port which has standard TTL voltage levels.

The model 800 is \$295 with the acoustical coupler and \$225 without the coupler. Cost of a 1/2-inch by 450 feet roll of paper is 25 cents. Special offer of 200 rolls of paper for \$20 when purchased with a model 800 terminal.

For further information contact Abacus Computer Systems, 6315 Eunice Ave., Los Angeles, CA 90042, (213) 666-1711.

CIRCLE INQUIRY NO. 199

## ACT-IA

Micro-Term's popular ACT-I computer terminal has been upgraded to include a descending lower case character set, cursor control and bell. All of these features have been included in the standard ACT-IA at a retail price of \$400.



Other standard features of the ACT-IA include a 64x16 display format of upper and descending lower case characters, switch selectable data rates from 110 to 19,200 baud, auto-scrolling after receipt of the 64th character on a line and RS232C interface.

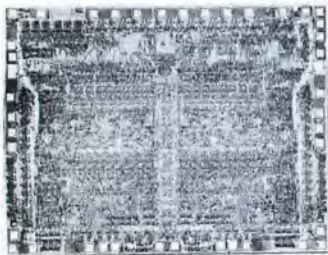
The ACT-IA comes completely assembled, tested and burned in for forty-eight hours. For further information contact Micro-Term, Inc., P.O. Box 9387, St. Louis, MO 63117, (314) 645-3656.

CIRCLE INQUIRY NO. 197

# I/O Cards

## Multi-Protocol Serial I/O Circuit

Zilog, Inc., has a high-speed, dual-channel, multi-protocol serial data communications controller circuit — the single-chip Z80-SIO — for advanced LSI microcomputer systems.



The serial input/output controller, an NMOS 40-pin device, is a multi-function peripheral component that can control communications peripherals and format data in data communications networks.

Designed to work with Zilog's Z80 microcomputer family and also easy to interface with most other 8-bit and 16-bit processors, the Z80-SIO supports the "Daisy Chain" interrupt structure of the Z80-CPU for fast, powerful interrupt processing with no added hardware overhead.

Pricing for the Z80-SIO in small quantities is \$54 in a 40-pin ceramic package and \$49 in a 40-pin plastic DIP. Delivery is off the shelf. For detailed information contact Zilog, 10460 Bubb Rd., Cupertino, CA 95014, (408) 446-4666.

CIRCLE INQUIRY NO. 225

## "Bit Streamer" I/O Board

A "Bit Streamer" I/O board is available in kit form or assembled from Vector Graphic, Inc.

The "Bit Streamer" design concept combines two parallel input and output ports, and a serial I/O port using an 8251 programmable universal synchronous/asynchronous receiver-transmitter. Communications with board cir-

cuitry is accomplished by the CPU. One parallel port also can be used as a keyboard input port.



The USART is designed to interface to an S-100 bus structure and is capable of being configured for a wide variety of communication formats.

Available from Vector Graphic computer store dealers, the board is priced at \$155 for kit, \$195 assembled. For more information contact Vector Graphic, Inc., 790 Hampshire Rd., A+B, Westlake Village, CA 91361, (805) 497-6853.

CIRCLE INQUIRY NO. 210

## S-100 Bus Interface

HUH Electronic Music Productions has the PET'S 100 — a PET to S-100 Bus interface board. This S-100 sized card plugs into the mainframe of your choice and a cable connects it to your PET which then enables you to use the wide range of peripheral and memory cards available for the S-100 bus. The PET'S 100 is unique in that it emulates the true S-100 bus including DMA, both read and write wait states, I/O address mirroring, multiplexed status lines and much more. This means you can use Dazzlers, Bytesavers, slow memory (like 1702s) analog interface and a whole host of other tricky cards.

The PET'S 100 will be available in kit or assembled form for \$199.95 or \$279.95 respectively, but a special introductory price is being

offered to those placing pre-paid orders before March 31st, 1978. This special offer is good for the kit version only and is \$169.95. Deliveries are scheduled to begin in April.

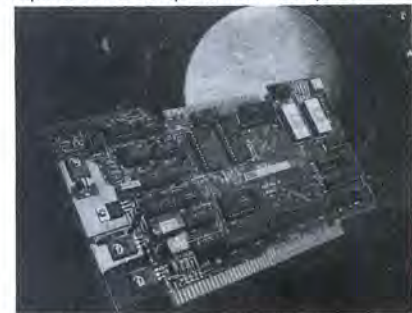
Come to the 2nd West Coast Computer Faire and see it running in Booth M-1. You may also place your order at the Faire.

Dealer discounts are available. For more information contact HUH Electronic Music Productions, P.O. Box 259, Fairfax, CA 94930, (415) 457-7598.

CIRCLE INQUIRY NO. 226

## MFIO-1 I/O Board

The new product designated the MFIO-1 is an S100 compatible general purpose I/O board which contains a major portion of all circuitry required for a complete microcomputer.



Some of the features include memory or I/O mapped parallel input port for keyboard, memory or I/O mapped serial I/O port with crystal controlled switch selectable baud rates of 50 to 19200, jumper selectable RS 232 or 20mA current loop, memory or I/O mapped cassette interface with switch selectable data rates of 300 (KC Standard), 600, 1200 and 2400 baud, 128 bytes of RAM, and slots for 2 each 2708 EPROMs. A 21 command, two chip monitor is available in PROM firmware as option 001. Total power requirement less than 1A.

The product is available assembled and tested, as a complete kit, and as bare boards. Single piece prices are: Assembled \$282; Kit



\$234; bare boards \$49; set of 2 ROMs \$65.95.  
For more information contact Infinite Inc.,  
1924 Waverly Pl., Melbourne, FL 32901.

CIRCLE INQUIRY NO. 204

### Adapter Doubles DECwriter Speed

The Larks ACCELEWRITER™ adapts any LA36 DECwriter to operate at 600 baud. The adapter converts the standard 110/150/300 baud DECwriter to 110/300/600 baud.



The ACCELEWRITER changes the internal timing of the DECwriter and causes it to print at 60 characters-per-second. Installation typically takes less than one hour and requires the removal of two integrated circuits from the logic board of the DECwriter. These are replaced with low-profile IC sockets. The ACCELEWRITER is then installed in the board in place of the two original ICs, and the logic board is reinstalled in the DECwriter.

Price is \$95.00 and delivery is from 2-4 weeks. Installation is available in selected areas. For more information contact Larks Electronics and Data, P.O. Box 22, Skokie, IL 60077, (312) 677-6080.

CIRCLE INQUIRY NO. 207

### 9650 Serial Interface

The 9650 is an asynchronous serial interface module specifically designed for compatibility with the M6800 microprocessor bus. It is pin and outline compatible with the Motorola EXORCiser™ and Micromodules™ and with the MEK6800D2 Evaluation Kit. It features full address decoding and fully buffered data, address and control lines. This module utilizes 8 MC6850 Asynchronous Communications Interface Adapters with full RS 232C signal conditioning. An on-board bit rate generator simultaneously provides 14 standard rates that can be individually strapped to each ACIA.



The standard configuration of the 9650 is fully populated to 8 channels. Prices range from \$395 in single quantities to \$237 at 100. For additional information contact Creative Micro Systems, 6773 Westminster Ave., Westminster, CA 92683, (714) 892-2859.

CIRCLE INQUIRY NO. 218

### Macro "Floppy" Controller Board

The S-100 compatible floppy disk controller, the FDC-108, is compatible with the 8080 or Z-80 powered S-100 computer system. Its major features include 8 drive capability (standard or mini), all necessary software included in on-board PROM, all addresses jumper selectable, IBM 3740 soft sector format compatible, jumper selectable wait state for 4 MHz opera-

tion, on board crystal controlled clock for maximum stability.

There are two models of the board, one for mini-floppy drives (5.25") and one for standard size drives (8"). The two versions are the same price.

The board is designed to control up to 8 drives in a daisy chain connection. It is compatible with PerSci, Shugart, Pertec, Calcomp, Memorex, Orbis and Remex drives and features 1024 byte PROM full of software to make disk operations easy for you to accomplish. All routines are accessed via a jump table.

For further information contact Computer Hobbyist Products, Inc., P.O. Box 18113, San Jose, CA 95158, (408) 629-9108.

CIRCLE INQUIRY NO. 221

### VDB-1 Video Display Board

The VDB-1 board is plug-in compatible with the SWTPC 6800. It is also compatible with any 6800 or 6502 based uP. Display format is 2 pages of 16 lines x 32 characters.



Software is included for scrolling, screen erase, etc. The board has provision for Pixieverter or direct video, and on-board regulation.

The bare VDB-1 Video Display Board, software and documentation is \$29. Add \$2.50 per order for S/H. (Doc. only, \$5 PPD, refundable with order.) Ohio residents add 4% sales tax. For more information contact F&D Associates, 1270 Todd Rd., New Plymouth, OH 45654.

CIRCLE INQUIRY NO. 206

### Analog Interface Board

A multi-function Analog Interface Board is offered as a kit or fully assembled from Vector Graphic, Inc. The board design permits interfacing with potentiometers, joysticks or voltage sources.



Price from Vector Graphic computer store dealers is \$75 in kit form, \$115 assembled. For more information contact Vector Graphic, Inc., 790 Hampshire Rd., A + B, Westlake Village, CA 91361, (805) 497-6853.

CIRCLE INQUIRY NO. 208

### 3 Serial and 1 Parallel I/O Interface

This I/O interface module features 3 fully independent serial I/O ports and one parallel port. Each of the four ports has its own status bit eliminating the need to use the parallel port for status. It is possible to use this port to drive 3 serial I/O device and the parallel device concurrently.

The serial I/O ports will drive either current loop or RS232 devices at all common bit rates from 75 to 9600 BPS. Each line may have a dif-

ferent speed. Bit rate and UART options are easily selected using DIP sockets programming without removing the port. The parallel port has TTL compatible inputs and outputs.

The board will satisfy all the I/O interface requirements for many systems and gives the user great flexibility through jumper operations.

Price of the board is \$165.00 in kit form and \$250.00 if assembled. Deduct \$15.00 without sockets. Delivery is in 2 weeks. For more information contact Franklin Electric Co., 733 Lakefield Rd., Westlake Village, CA 91361, (805) 497-7755.

CIRCLE INQUIRY NO. 214

### Isolated Digital Output Boards

Plug compatible 16- or 32-channel isolated digital output systems are available from Burr-Brown for Intel SBC 80 and Intellect MDS microcomputers. Isolation eliminates ground loop problems and protects the CPU from real world transients and malfunctions.



Memory mapped MP801 (16-channel) or MP802 (32-channel) systems are contained on a single PCB and provide all control and timing circuitry. Channels are implemented by dry reed relays protected by metal-oxide varistors and can handle up to 10 watts. Relays, with a life of 10<sup>8</sup> operations, provide low "on-impedance," high output current and isolate output channels from the computer bus (to 600 VDC) and from channel-to-channel (300 VDC).

Prices of the 16-channel MP801 are \$295 (1-9) and the 32-channel MP802, \$475 (1-9). Contact Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 223

### Array to Market Aviv Controllers

Array Computer Marketing, Inc., has announced it will market Aviv Corporation's magnetic tape controllers for PDP II Unibus computer and Data General computers.

The controllers are fully plug to plug compatible with DEC's operating systems and Tm II/TU 10 hardware, as well as Data General's operating systems. There are two controller offerings for each, the DEC line and the Data General line. The offerings are an NRZI tape controller that offers the user high reliability at low cost, and a dual density tape controller for NRZI and/or Phase-Encoded formats. The controller supports the industry standard speeds of 12.5, 25, 45, 75 and 125 ips.

For further information contact Array Computer Marketing, Inc., 130 E. 40th St., New York, NY 10016.

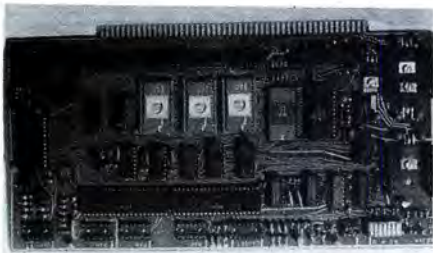
CIRCLE INQUIRY NO. 224

### Microcomputer Card: SCI

The System Central Interface, or SCI is designed for the hobby S-100 bus. The SCI provides a serial port, with RS-232, 20ma and 60ma current loops, and speeds from 45 to 9600 baud; three independent 8-bit parallel ports which can be programmed bit-wise for input or latched output; a high-speed biphase (Tarell) cassette port, with data speeds from 800 to 100,000 baud, two on-board relays for control of two recorders, and three status lines to control an automatic tape deck; 256 bytes of RAM for stack space and buffer storage; a 2708 pro-



grammer; space for three 2708's; two 2708's provided, with a 2k system monitor program.



The standard 2k monitor provides 18 commands which allow the user to display and alter memory, verify, move and zero memory, assign I/O devices (up to 3 in and 3 out), read, write, and verify magnetic tape, search memory for character strings, do HEX arithmetic, program 2708's, and a complete driver for a memory-mapped video interface. The SCI monitor has 9 jump instructions at the beginning of the program which are called by system programs to provide the full range of I/O available with the System Central Interface.

For further information contact Dajen Electronics, 7214 Springleaf Ct., Citrus Hts., CA 95610, (916) 723-1050.

CIRCLE INQUIRY NO. 215

### Data Expansion Buffer

Users of Printronix Printer/Plotters can now increase the throughput of their system with a Data Expansion Buffer from USDATA Engineering, Inc. The Buffer, designated Model P512, is on a printed circuit board that plugs directly into a spare slot in the Printronix unit.



It is transparent to system interfaces and software, and requires no modification to the printer/plotter. Typical results are 50% increase in plotting applications, and 25% in printing. For information contact USDATA Engineering, 14241 Proton Rd., Dallas, TX 75240, (214) 661-9633.

CIRCLE INQUIRY NO. 209

### RS-232 Adapter for KIM

Connecting an RS-232 terminal to KIM is easy with ADA. This ADAPTER converts KIM's 20ma current loop port to an RS-232 port.



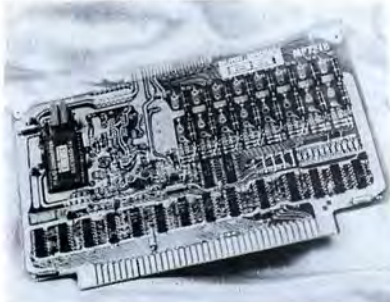
ADA does not affect the baud rate and uses standard power supplies. The unit comes complete with instructions, is assembled and tested, and measures 3"x3½"x1". KIM is isolated from the RS-232 device by optoisolators.

ADA sells for \$24.50 with drilled, plated through solder pads for all connections, or for \$29.50 with barrier strips and screw terminals. For more information contact Connecticut microComputer, 150 Pocono Rd., Brookfield, CT 06804, (203) 775-9659.

CIRCLE INQUIRY NO. 219

### Low-Cost Analog Input System

The MP7218 Analog Input System is a complete data acquisition system that accepts either 8 differential or 16 single ended analog inputs and converts signals to 12-bit digital outputs. Input signal ranges vary from  $\pm 10\text{mV}$  full scale to  $\pm 5\text{V}$  full scale, eliminating the need for external instrumentation amplifiers for low-level signals.



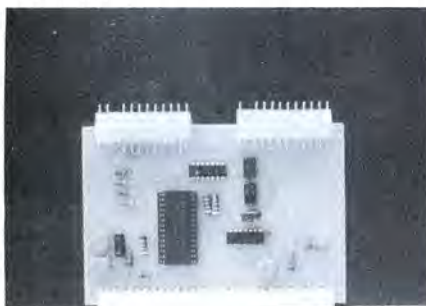
The unit is both hardware and software compatible with the Motorola microcomputer systems. It operates from the microcomputer's +5VDC and  $\pm 12\text{VDC}$  supplies and it is treated as memory by the CPU. Two memory locations are required per 12-bit channel, and any memory reference instruction may be used to input data. The unit may be used with or without halting the CPU, or in the interrupt mode.

The MP7218 is priced at \$495 in quantities of 1 to 9. For more information contact Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 222

### Calculator Interface

The NCU-1 is a scientific and floating point calculator interface built around the National Semiconductor MM57109 "Number Crunching Unit" IC. It handles all common math and trig functions without extensive or expensive software. Lets your micro enter numbers and get results as easily as you do with an ordinary calculator.



Plugs into one I/O slot of the SWTPC 6800 to get its power. Connects to a MP-L or MP-LA board for communication. Adaptable to general purpose I/O ports of other uP's. Controlling subroutines for the SWTPC 6800 are included as well as a separate exerciser program that lets you use your terminal as a calculator.

From stock. Bare board & documentation \$19. Add \$2.50 per order S/H. (Doc. only \$5 PPD, refundable with order). Ohio residents add 4% sales tax. For more information contact F&D Associates, 1270 Todd Rd., New Plymouth, OH 45654.

CIRCLE INQUIRY NO. 205

### New Controller

Introl is a new system designed to simply and economically control AC devices remotely from any S;100 bus or Apple II computer over existing 110 VAC wiring in homes, factories, schools and businesses.



Price of the AC controller is \$149 in kit form, \$189 assembled and tested. Dual Channel AC Remotes are \$99 in kit form, \$149 assembled and tested. A Calendar/Clock Board is \$179 in kit form, \$219 assembled and tested. Delivery is stock to 30 days. For more information contact Mountain Hardware, Inc., P.O. Box 1133, Ben Lomond, CA 95005, (408) 336-2495.

CIRCLE INQUIRY NO. 220

### Printer Interface For Apple II

Microproducts has a printer interface for the Apple II Computer which is compatible with the SWTP PR-40 Printer.



The complete plug-in interface with software sells for \$49.95. Contact your local computer store or Microproducts, 1024 17th St., Hermosa Beach, CA 90265, (213) 374-1673.

CIRCLE INQUIRY NO. 212

### SC/MP Extender Board Kit

This dual purpose board can be used either as an extender board capable of plugging into our SC/MP Motherboard and adding an additional 5 plugs or it can be used as a vertical extender board for card accessibility during trouble shooting.



The kit includes one high quality printed circuit board and one 72 pin edge connector. Additional 72 pin edge connectors may be purchased separately to obtain the desired configuration. The Extender Board Kit sells for \$25.00, plus \$2.00 shipping and handling.

For further information contact BW Ward Enterprises, P.O. Box 8122, Long Beach, CA 90808.

CIRCLE INQUIRY NO. 217



### 8010 Bus Compatible Floppy Disk Controller

A single board, 8010 bus compatible floppy disk controller with an IBM-compatible format is available from GSI Systems.



The 10043 Floppy Disk Controller is a microprocessor-based disk control card that accepts commands from an 8010 CPU card (host computer) via the 8010 backplane. It has an IBM-compatible format with 3328 bytes of data per track (77 tracks total); a non-OBM-compatible high capacity option formats each track with two sectors containing a total of 4096 bytes. The 10043 Floppy Disk Controller can control up to four disk drives, and it is equipped to perform internal CRC checks, self test, and status and error reporting.

The 10043 sells for \$495.00 in single units, available from stock. For more information contact GSI Systems, 223 Crescent St., Waltham, MA 02154, (617) 899-6688.

CIRCLE INQUIRY NO. 213

### The VDB (Video Display Board)

The VDB is a video interface for the S-100 bus microcomputers.

The VDB is low in cost and yet provides the capabilities of much more expensive video terminals. The VDB contains its own display buffer memory and provides two pages of display, each with 25 rows of 80 characters.



The board displays, in addition to the 96 upper and lower case ASCII characters with descenders, 64 unique display symbols, permitting a graphic resolution with 160 horizontal elements by 75 vertical elements. The display can accept data at a 400,000 character per second rate.

The VDB is priced at \$369 assembled and tested. Software character and graphics output drivers for Z80™ and 8080 systems are supplied. For additional information contact Technical Design Labs, Research Park, Bldg. H, 1101 State Rd., Princeton, NJ 08540, (609) 921-0321.

CIRCLE INQUIRY NO. 216

### PC/M Reader/Punch, Mag-Tape

Pacific Cyber/Metrix, Inc., has added two modules to support its PCM-12 microcomputer system. Both modules—a High-Speed Reader/Punch Interface and a Mag-Tape Interface—are available either in kit form or fully assembled, with delivery in three weeks ARO.



The Reader/Punch module, designated the 12070, interfaces the Addmaster model 601 paper-tape reader and the Epson model 6110 paper-tape punch to the PCM-12 microcomputer. Unit price in kit form is \$97; assembled, \$167.

The Mag-Tape Interface Module—the 12080—allows an ordinary audio cassette recorder to be substituted for the paper-tape reader and punch. The modules come supplied with full instructions for installation and use. The single-quantity price as a kit is \$117; fully assembled, \$187.

For more information contact PC/M, 3120 Crow Canyon Rd., San Ramon, CA 94583, (415) 837-5400.

CIRCLE INQUIRY NO. 211

# Memory Cards

### PROM/RAM Board

A new PROM/RAM board, offered assembled or in kit form, occupies two independently addressable 8K blocks and has a 1K on-board RAM and capacity for up to 12K 2708-type EPROMs. Complete addressing flexibility is provided to conform to virtually any system configuration with a minimum of address jumpers required.



Available immediately, the board is priced at \$135 in kit form, \$175 assembled. For more information contact Vector Graphic, Inc., 790 Hampshire Rd., Westlake Village, CA 91361.

CIRCLE INQUIRY NO. 229

### Mostek's 64K ROM

Implemented with a new Edge-Activated™ circuit design concept, Mostek's new ROM operates at faster speeds than traditional ROM designs, but with much lower power dissipation and smaller chip area. The MK 36000 (8Kx8) operates at a fast 200 ns access time, but requires only 200mW active power (max) and 25mW standby power. With this low power rating, system designs cost less. Another important advantage is ease of use. The MK 36000 operates from a single +5V power supply with

210% tolerance providing the widest operating margin available.



Mostek's edge-activated design concept integrates a static MOS storage cell with dynamic MOS periphery so that the full advantages of the technology can be realized. All devices (ROMs and RAMs) are activated by one common timing signal. For more information contact Mostek Corp., 1215 W. Crosby Rd., Carrollton, TX 75006, (214) 242-0444.

CIRCLE INQUIRY NO. 228

### 32K Static Memory Board

Microbyte announces their 32K fully static S100 bus memory board. Being fully static, the board works with everything (DMA, disk controllers, etc.), completely eliminating the incompatibilities often associated with dynamic or clocked static memory.

Available immediately at your local computer store. Also available is a half populated 16K version that expands to 32K simply by adding memory chips. Dealer inquiries invited. For more information contact Microbyte, 1653 E. 28th St., Signal Hill, CA 90806, (213) 595-5567.

CIRCLE INQUIRY NO. 232

### High Performance 16K RAM

The 16K RAM is designed for use in both 8080 and Z80 computer systems. It will operate at full speed (zero wait states) even at 4MHz.

The low-power board uses 200 ns dynamic RAM chips and the on-board memory refresh is invisible to the processor. Bank switching capability is provided and the addressing of the board is switch-selectable in two 8K sections.



An important feature of the board is the availability of a parity check option. The 16K RAM board is offered in kit form at \$399 and fully assembled at \$459. The parity option costs \$39 in kit form and \$59 assembled. For further information contact North Star Computers, Inc., 2547 Ninth St., Berkeley, CA 94710, (415) 549-0858.

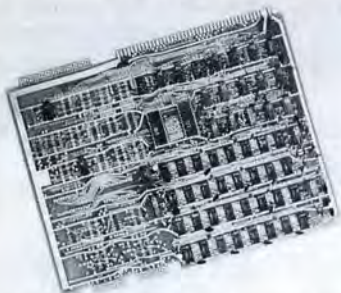
CIRCLE INQUIRY NO. 227

### 64K RAM Board

The 10046 64K RAM Board is a direct replacement for four Intel or National Semiconductor SBC 8010 16K RAM boards, and frees space for boards with other functions. Providing a 475ns access time and a 650ns refresh, the 10046 is compatible with a standard SBC 8010 backplane. Two serial I/O ports



capable of providing RS232C or current loop interface may be incorporated, to permit the board to communicate with various peripherals, terminals and modems.



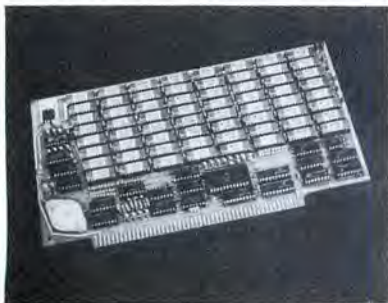
The 10046 64K RAM board provides all of the necessary logic and circuitry to perform accessing, reading, writing, transparent refresh, time out refresh, and direct memory access (DMA). Its logic resolves conflicts between refresh and normal or DMA operations so that both cannot occur simultaneously.

The 10046 64K RAM board sells for \$179 in single units. The 16K version sells for \$495. Both are available from stock. For more information contact GSI Systems, 223 Crescent St., Waltham, MA 02154, (617) 899-6688.

CIRCLE INQUIRY NO. 240

### The D32 Memory Board

The D32, designed for the S-100 bus, will replace and outperform the Z16. It features extremely low access times, very low power consumption and all refresh timing is generated on the board. It is in the medium price range.



The D32 utilizes TMS 4050-2 or AM9050E 18-pin dynamic memory chips which are organized 4096x1 and have a worst case access time of 200ns. Careful optimization of on-board logic gives the D32 worst case access time of 280ns. It will operate at microprocessor clock speeds of 4Mhz.

Modules are available as completely assembled and tested units and are priced at \$869 in quantity one. For further information contact Technical Design Labs, Research Park, Bldg. H, 1101 State Rd., Princeton, NJ 08540, (609) 921-0321.

CIRCLE INQUIRY NO. 231

### 16K RAM Board

Central Data has a new 16K RAM board designed for S-100 computers. The board sells for \$289.



The board uses a reliable refresh method

which inserts refresh cycles between the computer's normal memory access cycles. This means no loss of performance of the computer.

The RAM board comes completely assembled, tested and burned in so that you can be sure of the board's reliability. It also carries a full one year warrantee.

The board has capacity for up to 32K of RAM. You can buy it with a full 32K of RAM (\$475) or add on 16K (\$200) later. For more information or to order, contact Central Data, P.O. Box 2484 Sta. A, Champaign, IL 61820, (217) 359-8010.

CIRCLE INQUIRY NO. 236

### Non-Volatile High-Speed RAM Memory

The Model 4020 Non-Volatile High Speed Semiconductor RAM Memory has a size and word width of 2Kx8/9 or 1Kx16/18, jumper selectable. The Model 4020 is a single card memory designed to meet the requirements for short and long term non-volatile high speed RAM systems. Memory data is maintained for a minimum of three months (six months typical) after the primary board power is removed.



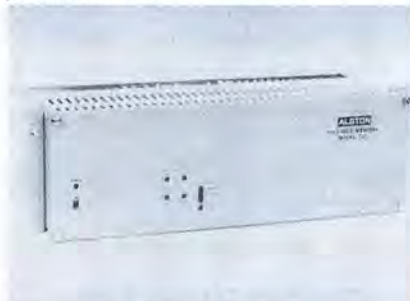
The 5x10 inch card features a 450ns access time, bank select within 64K, 5V or 7 to 10V power input at 260ma, phase programmable operating controls, separate data inputs and outputs that may be bussed together, 100 pin edgecard or ribbon cable interconnect, S100 data bus compatibility, on-board address registers for A0 through A9, and LS type TTL interface.

Single unit price is \$287.00. For further information contact ElectiCom, 12567 Crenshaw Blvd., Hawthorne, CA 90250.

CIRCLE INQUIRY NO. 233

### Pollable ASCII Character Buffer

The new, high capacity, pollable ASCII character buffer, the Model 721Z, is designed for data or message buffering in centralized polling applications over switched public telephone networks.



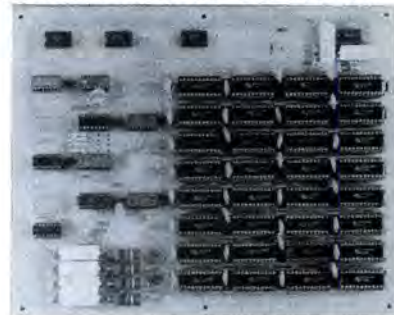
The new unit consists of a microprocessor-based control section and up to 16 memory modules, all contained in a small card file. The card file may be cabinet, relay rack, or desk top mounted. The 721Z is equipped with an input port for attaching the data/message source. An output port connects to a telephone line for polling by a distant location via dial-up connection over the public switched network.

For additional information contact Conrac Corp., Alston Div., 1724 So. Mountain Ave., Duarte, CA 91010, (213) 357-2121.

CIRCLE INQUIRY NO. 235

### Static RAM Memory

The low cost VERSIRAM 16Kx8 bit static RAM memory board has an access time of 200 nsec and a read/write time of 300nsec. The board has four 14-pin DIP type sockets for power and signals. It is easily interfaced to many hobbyist or homebrew buses. The address lines are TTL compatible and the data resides on a bidirectional three-state bus.



The start address is selectable in 4K increments from 0 to 52K. The required voltages are +12v, +5v, and -5v. The board is fully socketed. A minimal 4K version is also available, with expansion to the full 16K by adding memory chips.

The price for the 16K version is \$550 for the kit and \$650 fully assembled and tested. For more information contact WWW Enterprises, P.O. Box 548, Harbor City, CA 90710, (213) 835-9417.

CIRCLE INQUIRY NO. 238

### Fully Static 64K ROM — in VMOS

American Microsystems, Inc. (AMI) has fabricated a 64K ROM with the new VMOS technology.

Designated the S4264, the 8K x 8 ROM yields substantial cost reductions by reducing the number of parts required, simplifying printed circuit boards and eliminating the need for clock signals to the ROM. In addition, the S4264 offers a maximum access time of 350 nanoseconds and reduces power requirements to only 145 milliwatts maximum for the 65,536 bit chip.



The 64K ROM is contained in a 24-pin package and requires a single socket to replace four 16K ROMs in existing designs for display terminals, plug-in computer language modules and numerous control applications in, for example, video games or industrial controls.

Evaluation products are available. Prices are negotiated on the basis of quantities ordered, but will be about \$50.00 in quantities of 500. Send product and literature inquiries to American Microsystems, Inc., 3800 Homestead Rd., Santa Clara, CA 95051, (408) 246-0330.

CIRCLE INQUIRY NO. 234

### 8K RAM Board

The 8KRS is a new 8K byte static RAM board for the S-100 bus. The memory is organized as two independently addressable 4K blocks with address selection by an easy to visualize jumper and plug system that can be changed even while the board is plugged in. Write protection for the entire board is provided by an accessible on-board toggle switch, and in addi-



tion write protection logic is provided to implement write protection of either or both 4K blocks via front panel controls in those systems containing this feature. Memory disable is implemented via the Phantom line and 0, 1, or 2 wait states are plug and jumper selectable. All bus lines are buffered with one LS TTL load per line.



The 8KRS is fully assembled and tested and is priced at \$199.95 for the 450ns speed and \$219.95 for the 250ns version. For more information contact Pacific Digital, 2555 E. Chapman Ave., Suite 604, Fullerton, CA 92631, (714) 992-5540.

CIRCLE INQUIRY NO. 239

## ECONORAM VI™

Designed specifically for the Heath Company H8 microcomputer, this 12Kx8 memory emphasizes cost effective design and uses proven static technology.



Organized as two separate blocks (one 8K block locatable on any 8K boundary and one 4K block locatable on any 4K boundary) to provide unique addressing options. Fully buffered address and data lines, dip switch selected block address, on board regulation and heat sinking, switch selected protect and phantom, sockets for all ICs, proper bypassing, and additional convenience features contribute to user flexibility.

Available in kit form (with required hardware and edge connector) for \$235 in single quantities at many computer stores. For information or direct mail order contact Godbout Electronics, P.O. Box 2355, Oakland Airport, CA 94614, (415) 562-0636.

CIRCLE INQUIRY NO. 237

## Magnetic Bubble Mass Storage

The DSD 640 is a DEC-software-compatible memory that combines reliability, ruggedness and high speed in a non-volatile memory system.

Designed to replace floppy disks in harsh environments, the DSD 640 has an average access time of 4 milliseconds. Maximum access time of the DSD 640 is 7.2 milliseconds.

The DSD640 has an expandable capacity with up to 519K bytes available in single card increments of 82K. The system also features a microprogrammed bipolar bit slice controller which supervises all memory operations and data transfers to the computer.

For information, pricing and delivery contact Data Systems Design, 3130 Coronado Dr., Santa Clara, CA 95051, (408) 249-9353.

CIRCLE INQUIRY NO. 230

# Test Equipment

## L.C.D. Analog D.P.M.

The Series 800 L.C.D. display Digital Panel Meter is housed in a standard 3½" analog meter case. The 3½ digit display is .75" high liquid crystal field effect, transreflective type, easily readable at 40 feet even under high light conditions.



The 800 is well suited to replace same physical size analog meters in existing installations, as well as new designs where a mixture of analog and digital displays are needed to maintain panel uniformity.

single unit price is \$69; \$45 in 100 quantity. For more information contact Dr. Otto Fest, International Microtronics Corp., 4016 E. Tennessee St., Tucson, AZ 85714, (602) 748-7900.

CIRCLE INQUIRY NO. 243

## \$39.00 3½ Digit DPM

The Model 73 is a bipolar, 3½ digit, DC powered LED display panel meter with an oem price of \$39.00. Also available are choices of various AC powered units. The Model 73 features .05% accuracy, and is available in four full scale ranges: 200mV, 2V, 20V and 200V.

Basic specifications are .05% accuracy, 50 ppm temperature coefficient, .43" LEDs with extra wide viewing angle, 80 dB common mode rejection ratio and over-voltage protection. Overload is indicated by blinking the display. The unit fits 3.17" to 3.20"W x 1.77" to 1.79"H cut-out with an optional version for the 9.25 x 4.55cm DIN standard cut-out at no additional cost.

The Model 73 is a low-cost, reliable DPM backed up by an extensive quality control pro-

gram and over 100 hours of powered temperature cycled burn-ins.

For more information contact Data Tech Div., Penril Corp., Richard Tassone, 2700 So. Fairview St., Santa Ana, CA 92704, (714) 546-7160.

CIRCLE INQUIRY NO. 257

## Solid State Oscilloscope

Intended for use in the hobbyist and field service areas, the PDC 200 offers complete portability at an affordable price. The unit is powered by two 9V batteries and incorporates an LED type display that is entirely solid state. The sweep ranges are from .1 seconds to .5 microseconds/division with voltage ranges from 100mv to 100v/division.



The PDC-200 is available in kit form, less batteries and probes for \$99.95 plus shipping, or completely assembled and tested for \$155.00 plus shipping. Probes are available for \$9.95 plus shipping. Delivery is 6-10 weeks ARO. For more information or to order contact Pyramid Data Corp., P.O. Box 532, Barrington, IL 60010.

CIRCLE INQUIRY NO. 241

## Microlog's Random Sampler

The Sampler is completely random. Its features include solid state electronics, yes and no indicator lights, momentary snap action push button switch, hand-held convenient size, battery operated with rechargeable nickel-cadmium battery and recharger. Options available include digital counter for number of sample and number of "yes" indications, remote triggering devices such as photoelectric cells

and micro switches and output to control other devices.



Designed for application where it is necessary to take a random sample to insure quality control, security checks, unbiased opinion polls, audit tests, etc., sample condition is indicated by a green "yes" and a red "no" light. Sample selection probability is controlled by a thumb wheel for selecting numbers from 00 to 99. If a thumb wheel setting of 60 is selected, then 60 percent of the samples will be selected randomly by indicating a "yes" condition. Priced from \$49.00 each in 100 lot quantities.

For further information contact Microlog Corp., 4 Professional Dr., Suite 119, Gaithersburg, MD 20760, (301) 948-5200.

CIRCLE INQUIRY NO. 254

## Logic Analyzer

Utilizing Bipolar memory circuits, Databyte, Inc. has developed a low-cost 24-channel logic analyzer capable of acquiring up to 256x24 data sets. The unit, called The DATALYZER, is designed for use in an S100 type computer system and has the additional capability of self-monitoring the S100 address and data lines by simply changing operating modes.

A significant feature of the DATALYZER is that it uses equipment that the average S100 system already has and does not require the use of an oscilloscope. The DATALYZER provides a unique solution for both digital circuit and analysis and software troubleshooting, eliminating the need for the more costly conventional logic analyzers.



The price for the DATALYZER kit is \$495, and \$595 assembled. Included are three probe assemblies, a system monitor on paper tape, and a comprehensive applications manual which can be purchased separately for \$7.50. Delivery is 4 weeks ARO, Middleton, WI. For more details contact Databyte, Inc., P.O. Box 14, 7433 Hubbard Ave., Middleton, WI 53562.

CIRCLE INQUIRY NO. 261

### Data Communications Test Unit

The time measurement module, ATM-1-1 will allow the Data Tech 9600 to measure ON or OFF time of any RS 232/V.24 control lead. For example, it will measure duration of carrier dropout on a Full Duplex (FDX) circuit. It also provides measurement of the time delays between any two interface signals.



The time generating module, ATG-1-1, provides flexibility in inserting delays where needed for a specific application. For example, the Data Tech 9600 can now perform such tasks as Full Duplex (FDX) or Half Duplex (HDX) automatic polling with a capability of sending a return message.

The U.S. domestic price of the Data Tech 9600 is \$2300. The modules are \$200 each. Delivery is within 30 days. For additional information contact Atlantic Research Corp., 5390 Cherokee Ave., Alexandria, VA 22314, (703) 354-3400.

CIRCLE INQUIRY NO. 258

### Low-Distortion Generator for \$175

B&K-Precision's new Model 3010 function generator offers convenience and excellent waveform accuracy at an affordable price. Frequency coverage is unusually wide, spanning 0.1 Hz to 1 MHz in six ranges, with each range providing linear 100:1 frequency control. The 3010 generates sine, square, TTL square and triangle waveforms.



Range and function selection is push-button controlled for fast, error-free operation. Frequency generation originates from a stable voltage-controlled oscillator (VCO) which can be varied on each range by the front-panel frequency control or the VCO external input. If a 0 to 5.5v ramp is applied to the VCO external input, the 3010 will provide a 100:1 output frequency change. When used in this manner, the 3010 can serve as a sweep generator for response measurements in audio and I-F circuits. When an audio signal is applied in place of a ramp, the 3010 will produce a direct FM output.

The B&K-Precision Model 3010 includes a detailed instruction manual. Available for immediate delivery at local electronic distri-

butors. For additional information, contact B&K-Precision, 6460 W. Cortland Ave., Chicago, IL 60635, (312) 889-9087.

CIRCLE INQUIRY NO. 256

### Intelligent Logic State Analyzer

The Model 532 is a compact, 32-channel microprocessor-based analyzer whose internal bus structure utilizes small applications-oriented circuit modules to expand the unit's capabilities.



Using an ordinary oscilloscope, the basic instrument captures and displays up to two hundred and fifty 32-bit words in hexadecimal (alphanumerics) or binary (1's and 0's). The 32 channels can be operated together or functionally split into "A" and "B" groups, each 16 bits wide and each separately clocked. Using this approach, the Model 532 is fully compatible with the latest generation of 16-bit microprocessor chips which multiplex address and data on the same pins.

The basic analyzer with 250 words of memory, 21 triggering modes, dual clocking, self-test and signature capability is \$1500 plus probes. The memory and interface modules each add \$150 to \$250 to the base price. Availability is 6-8 weeks. For more information contact Paratronics, Inc., 800 Charcot Ave., San Jose, CA 95131, (408) 263-2252.

CIRCLE INQUIRY NO. 251

### DIP Jumpers

DIP Jumpers are used for jumpering within a PCB Board; inter-connecting between PC boards, backplanes and mother boards; and interfacing input/output signals.

DIP Jumpers are available in 14, 16, 24 and 40 pin single-ended or double-ended assemblies. Standard lengths are 6, 12, 24 and 36 inches. Custom lengths may be special ordered. DIP jumpers mate with standard IC sockets and feature molded-on strain relief, line-by-line probeability and are fully assembled and tested.



DIP Jumper contacts are non-corrosive copper alloy 770 spring temper. Insulator is white polyester thermoplastic, rated 94 V-O. Cable may be specified electric pink, rainbow or ground plane. All cable is grooved top and bottom for easy tear down and all cable conductors are #28AWG stranded 7/36 tin coated copper. Double ended assembled are wired pin 1 to pin 1, pin 2 to pin 2, etc.

For more information contact A P Products, Inc., 72 Corwin Dr., Box 110, Painesville, OH 44077.

CIRCLE INQUIRY NO. 245

### Better Bug Trap

The Better Bug Trap is an S-100 bus plug-compatible board providing functions for software debugging and real-time processing. Four hardware breakpoints anywhere in memory detect all memory accesses, not just instruction fetches as with software breakpoints. Real-time functions include time-of-day clock, interval timer, and watchdog timer.



The Better Bug Trap generates its own interrupts and services them with a CALL instruction to a subroutine anywhere in memory. All functions, timing, breakpoints, and subroutine addresses are set easily by software. Documentation includes a hardware manual with schematics, a software manual, and a software package on paper tape with relocating loader for setting the board's functions.

The Better Bug Trap is assembled, tested and delivered from stock for \$180.00. For more information contact Micronics, Inc., P.O. Box 3514, Greenville, NC 27834.

CIRCLE INQUIRY NO. 259

### Cramer Timer

The 635D Elapsed Time Indicator can operate on any voltage from 4 to 40 VDC without adjustment. The terminals are of the quick-disconnect type with no need to observe polarity.



The one-inch diameter wheels provide a digital readout that is legible up to six feet away. Rugged, black, high-impact styrene housing protects the unit from possible damage.

The 635D mounts in a 2 1/2 inch diameter panel hole. Barrel depth is only 3 1/8 inch behind the 2 1/8 inch diameter mounting flange. The unit records up to 99999.9 hours and functions with high accuracy over a temperature range of -20°C to +55°C. For further information contact Cramer Div., Conrac Corp., Mill Rock Rd., Old Saybrook, CT 06475, (203) 388-3574 (W. Buckman).

CIRCLE INQUIRY NO. 250

### New Intel Microcomputer Instrument

The USCOPE™ 820 Microprocessor System Console is a portable microcomputer system developed to support OEM test and maintenance. The USCOPE 820 console provides active control over microprocessor-based systems and is designed to expedite troubleshooting in lab, production test, repair-depot and field-maintenance applications.

Although the console is small, portable, and low in cost, it offers many of the powerful active control and diagnostic functions of the Inteltec® Microcomputer Development system. These functions are provided by the console's



8085-based microcomputer system, an advanced resident monitor program and the key-board-display panel.

For further information contact the Cramer Technical Literature Center at 85 Wells Ave., Newton, MA 02159, (617) 969-7700, or by calling any nearby Cramer distribution center.

CIRCLE INQUIRY NO. 249

### Frequency Counter

The Digital Group's hand-held frequency counter, which weighs 4 oz. and is seven inches long, is totally portable and affordable. The two operating ranges (10HZ-1MHz and 1KHZ-30MHz) of the frequency counter give it the precision of a laboratory instrument, yet the counter's price tag of \$99.95 assembled puts it in the price range of the hobbyist and home user.



Because it is portable, this frequency counter can be used anywhere a crystal or adjustable clocking device is needed — for adjusting computer clocking signals or ham operating stations, for electronic servicing or any of a myriad of applications.

For details contact W.V. Honeyman, The Digital Group, Inc., P.O. Box 6528, Denver, CO 80206, (303) 777-7133.

CIRCLE INQUIRY NO. 260

### AVR's Catch-A-Pulse

The new CATCH-A-PULSE Experimentor, the most fundamental type of digital test equipment, uses a new pulse accumulator. The LEDs will respond to single pulses up to 20usec. and will accumulate multiple pulses in pulse trains for frequency response greater than 40 MHz. The logic probe is compatible with RTL, DTL, TTL, CMOS, MOS and microprocessors using a 3.5V to 15V power supply.



Thresholds are automatically programmed. No adjustments are required. There is a visual indication of logic levels, using LEDs to show HI, LO, Bad Level or open circuit logic and pulses. It is highly sophisticated and has shirt-pocket portability, with a protective cap over the tip and a removable coiled cord.

CATCH-A-PULSE eliminates the need for heavy test equipment. Economically priced at \$22.95. For more information contact AVR Electronics, Box 19299, San Diego, CA 92119, (714) 447-1770.

CIRCLE INQUIRY NO. 244

### LP-3 High Speed Logic Probe

The LP-3 High Speed Logic Probe boasts the capability of catching pulses as brief as 10

nanoseconds. High and low logic states are read independently. A pulse stretcher and detector working with positive or negative-going leading edges lights a third LED. A slide switch selects TTL/DTL or CMOS/HTL logic family operation.



Power is derived from the circuit under test. The input impedance of the LP-3 is 500K to prevent circuit loading. It is priced at \$69.95. For more information contact Continental Specialties Corp., 70 Fulton Ter., New Haven, CT 06509; (203) 624-3103.

CIRCLE INQUIRY NO. 248

### DP-1 Digital Pulser

The new DP-1 Digital Pulser can deliver single pulses or pulse trains to help troubleshoot digital circuitry. A tiny slide switch sets up the logic pulser for either CMOS/HTL or TTL/DTL logic families. An LED blinks with each individual pulse or glows steadily during pulse trains. The substantial current output in each pulse enables troubleshooting without desoldering, unplugging or isolating, and internal circuitry monitors the node being probed, then presets the dual mirror output circuitry to pulse the node the other way.



The DP-1 is priced at \$74.95. For additional information contact Continental Specialties Corp., 70 Fulton Ter., New Haven, CT 06509, (203) 624-3103.

CIRCLE INQUIRY NO. 247

### Solderless Breadboard

The EXP4B Quad Bus Strip provides 4 rows of interconnected tie points, 40 tie points per row. And it's just \$4.00.



Other Experimentor Boards include the EXP350, a 3.6" long solderless breadboard featuring two 20-pin bus strips, 46 five-tie-point terminals, and standard DIP IC .3" center spacing, for \$5.50; the EXP650, with all the above features but with .6" center spacing to accommodate LSI DIP IC devices, for \$6.25; the

EXP300 is 6" long with two 40-pin bus strips, 94 five-tie-point terminals and .3" spacing for \$9.95; the EXP600 is 6" long with the same features, but .6" spacing for \$10.95.

For more information contact Continental Specialties Corp., 70 Fulton Ter., New Haven, CT 06509, (203) 624-3103.

CIRCLE INQUIRY NO. 253

### Wrapid Scan

Zia Associates, Inc. has available a new test instrument called Wrapid Scan I model 208-951. Wrapid Scan is a high speed continuity tester designed for use in inspection and quality control. Some of the applications include testing for proper continuity and errors between multiple terminals on wire wrap boards, main frames, cable assemblies or other interconnect equipment.



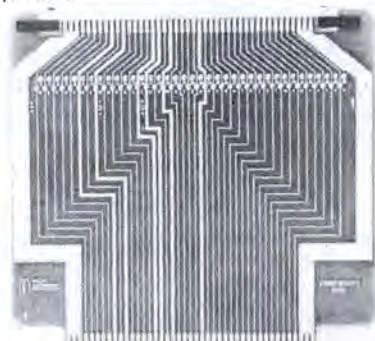
Manual "buzz testing" usually absorbs about one third of the labor applied to a wire wrap board. With Wrapid Scan this manual "buzz testing" time can be reduced as much as 85 per cent. Plus, Wrapid Scan verifies all combinations in seconds thereby assuring total accuracy with a substantial savings in both time and money.

For additional information contact Zia Associates, Inc., P.O. Box 1466, Boulder, CO 80306.

CIRCLE INQUIRY NO. 255

### Card Extender

The 9630 is a passive card extender that is pin and outline compatible with the Motorola EXORciser™, Micromodules™, and Evaluation Kits. It is a troubleshooting aid that extends any of the card family members to a position external to the card cage for easy access. The 9630 is equipped with labeled test point terminals on each of the system bus lines for ease of measurement or attachment of probes.



The 9630 is one of a family of M6800 support modules. It is available at \$60 in single quantity from Creative Micro Systems, 6773 Westminster Ave., Westminster, CA 92683, (714) 892-2859.

CIRCLE INQUIRY NO. 252

### Experimentor™ Sockets Solderless Breadboards

Small hardware additions can add big flexibility to personal computing systems. The newly expanded line of Continental Specialties Experimentor™ sockets solderless breadboards makes it easier than ever to add small bits of hardware.





The experimenter boards are referred to as byte-size breadboards. They allow experimentation with addressable I/O devices; for example, additional UARTs, or whatever bit of new circuitry the professional computerist is inter-

ested in. The five models of CSC Experimenter sockets are priced between \$4.00 and \$10.95.

For further information contact Continental Specialties Corp., 70 Fulton Ter., New Haven, CT 06509; (203) 624-3103.

CIRCLE INQUIRY NO. 246

### TDK Expands Accessory Line

TDK Electronics Corporation has expanded its accessory line with the addition of two new products: a precision Head Demagnetizer and a compact Head Cleaner Kit.

The Head Demagnetizer, patent pending, is unique in both its format and quality of operation. The head demagnetizer comes in the cassette format, with all electronic circuitry within, and is self-powered via a 1.5V drycell battery. Simply slip the Head Demagnetizer cassette into the deck, push "play", and within a few seconds, a red LED lights up to let you



know your deck heads are completely demagnetized.

The Head Cleaner Kit is a complete cleaning arsenal in a very small package. The mirror, brushes, pads and liquid are all within a cassette box. For more information contact Michael Galvin, TDK Electronics Corp., 755 Eastgate Blvd., Garden City, NJ 11530.

CIRCLE INQUIRY NO. 242

## Power Supplies

### Energy Saver Console Assembly

Terminal Data has developed a new console assembler for microprocessor users which enables them to conserve energy.

The Model 3800K Energy Saver Console Assembly consists of an indicator light, off-on switch, electronic circuit, connecting cables, and an attractive console. The console can be wall or desk mounted. One or two receptacles and a receptacle box, available at any hardware store, completes the unit.



Full assembly and test instructions are included. The Model 3800K sells for \$24.50. Assembly and test time is approximately two hours. Available from many computer stores, or Terminal Data.

The Model 3800K Console Assembly enables the user to turn on or off up to four devices at a time and have a visual reminder that the power is off or on. The Model 3800K is designed for standard home circuits (20 AMP service). For more information contact Terminal Data Corp., 11878 Coakley Cir., Rockville, MD 20852, (301) 881-7655.

CIRCLE INQUIRY NO. 263

### Tri-Power Mate

Amber Electronics introduces a laboratory power supply with three separate outputs.

The unit features 5 VDC, +15 -15 VDC, and 0-30 VDC (variable) with current limiting — 10MA, 50MA, 100MA, 500MA, 1A and 2A.

Other features also include complete short circuit protection and an excellent line and load regulation and transient rejection with very nominal ripple in all three outputs. Variable and voltage current are monitored by a voltmeter and an ammeter.

Price is \$195.00. For more information contact Amber Electronics, 17752 Sky Park Blvd., Suite 120, Irvine, CA 92714.

CIRCLE INQUIRY NO. 266

### Compact New Power Supply

Designed specifically to power a full Kimsi system (including KIM, Kimsi, and eight S-100 boards), the Kimsi-Plus Power Supply would

also be an excellent choice for powering any S-100 system with 8 to 10 motherboard slots.



The Kimsi-Plus provides complete power for the S-100 bus in a single high quality unit.

The Kimsi-Plus Power Supply is available with all parts including LED power-on indicator and power output connector pair for \$69.50 in kit form or \$89 assembled. For further information contact your local computer dealer or Forethought Products, P.O. Box 8066; Coburg, OR 97401, (503) 485-8575.

CIRCLE INQUIRY NO. 264

### Floppy Disk Power Supply

The AED 101 Triple Output supplies +5 VDC @ 12 amps, -12 VDC @ 0.7 amps, and +24 VDC @ 3.5 amps. It contains all the features you need such as switching regulation of +5 volts, foldback limiting, current limiting, and short circuit protection.



The AED 101 is compact and available immediately. The cost is \$137.50 in large production quantities - 90¢/watt, and has field-proven reliability. For more information contact Robin

at Advanced Electronics Design, Inc., P.O. Box 61779, Sunnyvale, CA 94088, (408) 733-3555.

CIRCLE INQUIRY NO. 262

### The PowerSource

Designed to be the most capable power supply on the microcomputer market today, the PowerSource can deliver over 500 watts to your system on demand. It supplies up to 32 Amps on the 8 Volt line, 8 Amps on the 16 Volt line, and also 8 Amps on the -16 Volt line.

Kit price is \$125. Also available in an 18 Amp version for small systems at \$75. For more information contact Data-tronics, 1671 Timmy Dr., Hamilton, OH 45011.

CIRCLE INQUIRY NO. 265

### Custom Switching Power Supplies

Many power supply customers have equipment applications which require features or operating characteristics not found in standard catalog units. The total quantity required sometimes justifies a specially designed unit. Gould offers this service to large users.



Where smaller quantities are involved Gould now makes it possible to buy a "modified" catalog unit. Standard power supply units which are customized are available in less time and at a fraction of the cost of a full custom design.

Gould customizes switching power supply units by reprogramming and adjusting off-the-shelf catalog units; assembling standard units into racks with control or sequencing logic, providing a series of output rails; redesigning catalog units to incorporate the parameters required by the application.

Inquiries regarding custom design, modified standard or off-the-shelf products should be directed to Gould, Inc., Electronic Components Division, 4601 Arden Drive, El Monte, CA 91731, (213) 442-7755.

CIRCLE INQUIRY NO. 358



# Components

## 10 Amp, 50nsec Rectifiers

Designed for multiple-output switching power supplies, two new recovery rectifiers have linear, guaranteed, forward-voltage drops throughout their 1.0Amp to 10.0Amp operating range. In many applications the devices eliminate the requirement for voltage regulation circuits. In others, the rectifiers' extremely-linear characteristics serve as the control source or permit use of only one regulator for multi-output supplies, reducing circuit complexity.



In 100 unit quantities, the rectifiers are priced from \$3.40 each to \$4.00 each, depending upon case style and delta forward-voltage-drop specified. Delivery is stock to 30 days.

For more information contact Solid State Devices, Inc., 14830 Valley View Ave., La Mirada, CA 90638, (213) 921-9660.

CIRCLE INQUIRY NO. 294

## Ion-Implanted Diodes

Two new ion-implanted diodes provide the fast switching and low forward voltage associated with Schottky diodes while exhibiting substantially better temperature characteristics, reverse leakage currents and an order-of-magnitude lower junction capacitance.



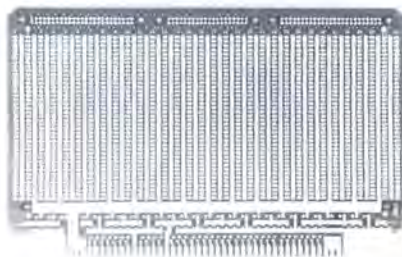
Designated the 1N6097E and 1N6098E, the device characteristics give significant efficiency improvement and reduced component count in conventional and switching power supplies to 100KHZ. The E designator signifies that the diodes are manufactured with SSDI's proprietary EPION® ion-implantation process.

The 1N6097E is priced at \$11.25 each and the 1N6098E at \$13.90 each in 100 piece quantities. Delivery is stock to 4 weeks. For more information contact Solid State Devices, Inc., 14830 Valley View Ave., La Mirada, CA 90638, (213) 921-9660.

CIRCLE INQUIRY NO. 293

## 9610 Utility Card

The 9610 utility card is a general purpose prototyping card that is pin and outline compatible with the Motorola EXORciser™, Micro-modules™, and Evaluation Kits. It features +5 volt and ground distribution in a generalized pattern with dedicated locations for bypass capacitors, and numbered columns of pads to allow the installation of any mix of dual-in-line devices with row spacings of 0.3 inches or multiples thereof.



Provisions are made for attachment of plastic wire guides to permit the use of "wiring pencil" type of interconnection if a low profile is desired or the card can be wrap-terminated. The top edge of the card accommodates two 50-pin and one 40-pin flat cable connectors. Maximum component density can be realized with 14-pin devices, 80 of which can be mounted.

The 9610 is available at \$36 in single quantity, \$28.80 at 10 to 24 from Creative Micro Systems, 6773 Westminster Ave., Westminster, CA 92683, (714) 892-2859.

CIRCLE INQUIRY NO. 281

## The "Exterminator"

The Exterminator (VTE 100) is a S-100 compatible card which puts an end to the many problems which plague S-100 computer systems. The VTE-100 is a dual function board. It terminates the entire S-100 bus using Industrial bridge terminating networks which eliminate crosstalk between busses, overshoots, ringing, and scrambling of data due to interference caused by extraneous noise. Secondly, the board serves as a card extender for any memory and/or I/O cards which may require analysis or maintenance.



The Exterminator comes fully assembled and tested for \$49.95 plus \$2 (\$4 foreign orders) to cover shipping and handling from VAMP, Inc., P.O. Box 29315, Los Angeles, CA 90029.

CIRCLE INQUIRY NO. 284

## Microprocessor Support Circuits

The Am8224-4 is a high-speed, clock generator containing a crystal controlled oscillator, a divide-by-nine counter, high-level drivers and auxiliary logic functions.

The 8238-4 is an 8-bit, bi-directional bus driver for buffering the Am9080A/8080A data bus from memory and I/O devices. The bi-directional bus driver is controlled by signals from a gating array for the proper bus flow and output control. It offers an extended memory write pulse width, making it ideal for use in large system timing controls.

These circuits are available in ceramic hermetic dual-in-line packages for use over the commercial operation range, and have undergone 100 percent processing to the requirements of MIL-STD-883.

Prices start at \$8.10 for the Am8224-4 and

\$8.15 for the Am8238-4 in 100-unit lots. They are available nationally from Hamilton/Avnet, Schweber or Cramer and regionally from Arrow, Bell, Century, Future, Liberty/Elmar, RAE, Sheridan and Summit. For more information contact E. Sopkin, Advanced Micro Devices, Inc., 901 Thompson Pl., Sunnyvale, CA 94086, (408) 732-2400.

CIRCLE INQUIRY NO. 287

## IEE•Proswitch

The IEE•Proswitch is a multi-legend illuminated pushbutton switch having 12 different selectable messages. The Proswitch can project each legend over all or part of the .62" square message area, thus legend count is not traded for legend size.



Up to three lamps can be energized at one time depending on cooling air temperature, yielding a maximum possibility of 64 different compound legends.

The Proswitch can replace pushbutton switches in most applications, displaying the equivalent of 4.6 square inches of legend area and requiring only 1.5 inches of panel space. Thus, a significant reduction can be made in hardware, wiring, and possibly, the number of equipment operators.

For more information contact Industrial Electronic Engineers, Inc., 7740 Lemona Ave., Van Nuys, CA 91405, (213) 787-0311.

CIRCLE INQUIRY NO. 295

## The PowerFrame

Designed to have the best of everything, this mainframe is the basis for a really great S-100 system.



We have combined the largest power supply: 8V at 32 Amps, 16V at 8 Amps, and -16V at 8 Amps; 5, 12 and -12V at .5 Amps each; the quietest motherboard: fully shielded between each line with active termination, 20 slots with 10 connectors supplied; and the perfect size cabinet: (room for two disk drives) which includes a fan and places for RS-232 connectors. Cabinet and bus board provide for the use of a front panel. Available with all the popular 8 and 16 bit CPUs. Priced at \$395.

System designers note: we will also put your system or business name on the front panel for a very small charge. Special cabinet sizes available. For information contact Data-tronics, 1671 Timmy Dr., Hamilton, OH 45011.

CIRCLE INQUIRY NO. 283



## Omni-Glow Panel Indicator Lights

A series of large, attention-getting panel indicator lights is available from Industrial Devices, Inc. The new Omni-Glow 2600 Series features an attractive built-in round metal bezel that retains the high dome-shaped lens or the low-profile flat or rounded lens that is used. The lenses are available in red, clear, amber, white, blue, green, and yellow transparent or translucent colors.



The indicators will fit into a 7/8-inch diameter round panel opening or in a keyed D-mounting hole. Either snap-fit mounting or speednut mounting may be used.

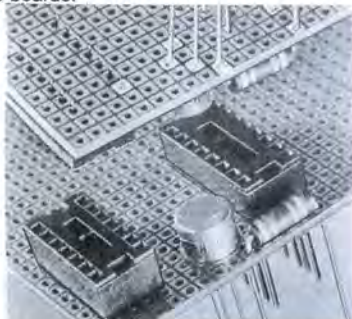
Lamps for the indicators may be either standard or high-brightness neons or rugged wire-lead incandescents in a wide range of voltages and currents. Connections to the indicators are either by means of wire leads or quick-connect terminals. Screw terminals are also available.

For additional information and samples contact Industrial Devices, Inc., 7 Hudson Ave., Edgewater, NJ 07029, (201) 224-4700.

CIRCLE INQUIRY NO. 109

## "Pad-Per-Hole" Boards

A family of large-area "pad-per-hole" plugboards permit convenient breadboarding of either custom circuits or S-100 bus compatible boards.



All boards have an isolated array of square solder pads surrounding 0.1 inch spaced holes. The 45P80-1 has a mounting area of 36.36 square inches, and the 106P106-1 has a mounting area of 112.36 square inches. Both boards are fabricated without card edge connectors and may be cut to any desired shape.

The third, designated the Model 8801, is form and fit compatible with the S-100 bus system, accommodates DIP devices, modules and discrete components necessary for micro-processor cpu, memory, and interface circuits.

The Model 8801 board is priced at \$19.95 each, the 45P80-1 is priced at \$9.96 each and the 106P106-1 is priced at \$18.99 each. Quantity discounts are available and delivery is from stock. For more information contact Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar, CA 91342, (213) 365-9661.

CIRCLE INQUIRY NO. 296

## High-Voltage Rectifiers

A new line of 2KV to 6KV rectifiers, rated at 250mA, exhibit an exceptionally low reverse current of 100uA at 125°C and only 8V maximum forward-voltage drop at rated current. Designated the HVM Series the devices dissipate a maximum of 2.8W, producing a rectifica-

tion efficiency of more than 99.8 percent. The units may be connected in series for operations to 150KV.



Controlled avalanche devices, the HVM Series accommodate peak recurrent transient voltages 1.2 times rated blocking voltage. They also withstand 30A current surges for up to 8.3 msec.

In 100 unit quantities, the HVM rectifiers are priced from \$0.90 each to \$2.00 each, depending upon blocking voltage. Delivery is stock to 30 days. For more information contact Solid State Devices, Inc., 14830 Valley View Ave., La Mirada, CA 90638, (213) 921-9660.

CIRCLE INQUIRY NO. 292

## Printed Circuit Test Jack

This horizontal test jack is designed as a low-profile, double-entry industry standard printed circuit test jack and meets MIL-C-39024/11.



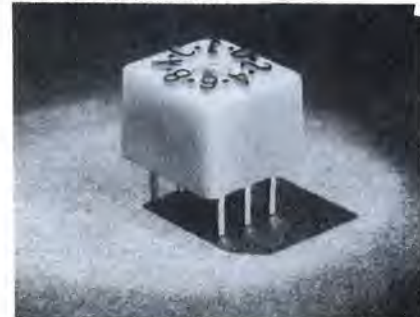
Dense packaging on .160 centers is possible because of the low profile and narrow width. These test jacks have a rugged molded nylon housing in various standard colors, and tough "hour glass" designed beryllium copper contacts of various finishes and printed circuit tail lengths. The double-entry design permits probe insertion from either end. An internal closed entry feature prevents the insertion of oversized probes.

For more information contact Eby Co., 4701 Germantown Ave., Philadelphia, PA 19144, (215) 842-3000.

CIRCLE INQUIRY NO. 289

## 16-Position DIP Switch

"MICRO-DIP" is a screwdriver-actuated mechanically programmed ROM and is available in a 16-position (hexadecimal) model. The 2-pole binary with separate commons to not true bits code is ideal for use with LSI devices such as MPU's.



Micro-DIP occupies only one-half the space

of other rotary DIP switches, and requires only 6 terminal pins for the hexadecimal code output. The .412 x .376 x .280 glass-filled nylon housing is yellow color-coded with large, easily-read characters. Contacts are gold-plated with terminals on .100 x .300 centers, allowing direct mounting to a PC board or in a DIP socket.

Priced under \$1.60 in 10K quantity, 8 week delivery for prototype units. For further information contact EECO, 1441 E. Chestnut Ave., Santa Ana, CA 92701, (714) 835-6000 "Switch Products."

CIRCLE INQUIRY NO. 278

## Card Edge Connectors

Two new series of high reliability card edge connectors from Eby Company are designed to be dimensionally and functionally interchangeable with those covered by MIL-C-21097. Designated at Series Cm with .100 centers, and Series CH with .156 centers, these connectors offer a variety of dual readout contact terminations of phosphor bronze with gold-over-nickel finish. The insulator material is thermoplastic polyester.



For additional information contact Eby Co., 4701 Germantown Ave., Philadelphia, PA 19144, (215) 842-3000.

CIRCLE INQUIRY NO. 291

## Low Drive Instrumentation Amplifier

The 3629 IC Instrumentation Amplifier offers very low voltage drive versus temperature even at low gains. With a drive of only 0.75 uV/°C max in the "C" versions, the 3629 meets critical instrumentation requirements for accuracy when amplifying low level signals in the presence of high common-mode voltages. Gain non-linearity is 0.003% max at G = 100 for "B" and "C" models.



The 3629 provides additional design flexibility. Its matched pair of amplifiers can be used as two independent, uncommitted op amps incorporating a laser-trimmed thin-film network in one self-contained package.

Units are priced at \$15.25 in 100's for the 3629AP, \$17.25 (100's) for the 3629BP and \$21.75 (100's) for the 3629CP. Delivery is from stock to 4 weeks.

For more information contact Naresh Shah, Marketing Engineer, Burr-Brown, Box 11400, Tucson, AZ 85734, (602) 294-1431.

CIRCLE INQUIRY NO. 285

## Readout Card Edge Connectors

Designated as Series CE, these connectors have precision stamped tuning fork contacts and are designed to be dimensionally and func-



tionally interchangeable with those covered by MIL-C-21097.



For additional information contact Eby Co., 4701 Germantown Ave., Philadelphia, PA 19144, (215) 842-3000.

CIRCLE INQUIRY NO. 290

### Elgin™ Key System with Circuit Breakers

Two new key system rectifiers with circuit breakers are available from Elgin Electronics Incorporated.

Designated Model EAK-4-CB (with a 30 Hz ringing generator) and Model EBK-4-CB (without ringing generator), the new units are designed to supply power for small switchboards, PBX telephone systems and private line equipment. Both models are U.L. Listed and U.L. Component Recognized.



Quality engineered and manufactured for efficient, long-term use, both models require no glass fuses, reducing the need for costly replacement units or repeated maintenance.

For more information contact Elgin Electronics Inc., 802 Walnut St., Waterford, PA 16441, (814) 796-2601.

CIRCLE INQUIRY NO. 276

### "Universal" Panel-Mounting Frame

EECO-14G frames are designed to hold standard sized pin-in-board, wire wrap panels with widths of 2.7", 5.4", 10.8" or 15.8" to a total width of 15.8". The frames can be assembled, or reassembled to hold either 6.9" or 7.5" high panels.



The panels mount on light weight, very rigid extruded aluminum side rails. The end pieces are form-stamped to give extra rigid support to the mounting rails and provide firm snap-in positioning in a 19" drawer. Depression of end pieces at the locking points permits the frame to be swung up for full access to either side of the mounting panel, or completely removed from the drawer.

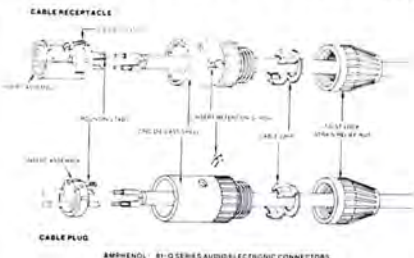
EECO-14G panel mounting frames are available assembled or in kit form. Single unit price is \$17.75 with delivery from stock.

For further information contact EECO, 1441 E. Chestnut, Santa Ana, CA 92701, (714) 835-6000 "EPP Products."

CIRCLE INQUIRY NO. 277

### Amphenol 91-Q Audio Connectors

A new line of durable, competitively priced, 3-, 4-, and 5-contact Amphenol® latch-lock type audio connectors has been announced by the Amphenol North America Division of Bunker Ramo Corporation. While fully interchangeable and interchangeable with all industry standard types, the new satin nickel-plated die-cast construction Amphenol connectors are fully 3/4-inch shorter overall, and the first to incorporate a unique, one-piece twist-lock type cable strain relief mechanism that eliminates all user need for associated screws and tools.



Called Amphenol 91-Q Series connectors, the line comprises 18 connectors in all (each of the three contact styles is offered in a choice of male or female cable plug or panel mount receptacle versions in standard, square flange, or round flange configurations).

For more information contact Amphenol North America Div., Bunker Ramo Corp., 900 Commerce Dr., Oak Brook, IL 60521, (312) 986-3748.

CIRCLE INQUIRY NO. 286

### Miniature Delay Timer

The Model 437 is a bantam, solid state, delay-on pull-in fixed timing device. It features great accuracy, fast reset time, high ambient operation and full 2 ampere solid state output capability.



For technical or pricing information contact Alan Seman, Artisan Electronics Corp., 5 Eastmans Rd., Parsippany, NJ 07054, (201) 887-7100.

CIRCLE INQUIRY NO. 279

### Fan-Cooled Switches

All JF Series switchers use integral but replaceable fans and are designed to generate almost two watts of power per cubic inch in a package measuring approximately 5" by 8" by 10 1/2" and weighing 20 pounds. Three versions are available: the JF120 (5V, 120A); the JF150 (5V, 150A), and the JF102. This last supply is available in two output configurations, 5.2V @ 16-80A and 2.2V @ 0-50 amps, and is specifically designed for powering ECL circuits.

Price for the JF120 is \$620; JF150 is \$695; and \$720 for the JF102, and all are stock units.

For details contact ACDC Electronics, Div. of Emerson Electric Co., 401 Jones Rd., Ocean-side, CA 92054, (714) 757-1880.

CIRCLE INQUIRY NO. 280

### Quarter-Micron NMOS FET

Silicon gate, NMOS field-effect transistors with gate geometries as small as 1/4 micron by 1/4 micron have been successfully fabricated using electron beam lithography and dry processing techniques.



During dynamic characterization of 61-stage ring oscillators constructed with this device, the 1/4 micron FET was shown to have an operating speed of 12 gigahertz.

For further information contact Rockwell International, Electronic Devices Div., 3310 Miraloma Ave., P.O. Box 3669, Anaheim, CA 92803, TWX 910-591-1654.

CIRCLE INQUIRY NO. 270

### Thumbwheel Switches Set Digital Time Delay Relay

A compact, low power consuming solid state time delay relay set by direct reading thumbwheel switches is offered by International Microtronics Corporation. Operating from an input voltage of 12VDC ± 10%, Series 280 "Digilay" is capable of timing, in ON or OFF delay modes, from 1mS to 9999 seconds. Accuracy and repeatability is ± 0.5%.

Maximum power turn on time is 30mS and minimum power recycle time is 10mS. An external frequency modulation feature permits fine tuning the oscillator's base frequency or, with an external wave form, actual modulation of the time delay.



Three switch options, SPDT relay, SPDT reed relay, and SPDT triac, are offered and provide a range of current handling capabilities and switching times ranging from 1 millisecond to 10 microseconds.

For more information contact Dr. Otto Fest, International Microtronics Corp., 4016 E. Tennessee St., Tucson, AZ 85714, (602) 748-7900.

CIRCLE INQUIRY NO. 273

### Addressable Peripheral Drivers

Two addressable peripheral driver integrated circuits which provide a simple and economic means of triggering relays, lamps, LED displays and step motors incorporated into microprocessor-based systems are available from Signetics.

Designated the NE590 and NE591, the new components are high-current latched drivers with 8 Darlington power outputs, each capable of 250 mA load current.

The driver ICs are similar in function to Sig-



netics' 9334 address decoder, with which the NE590 is pin compatible.

In quantities of 100, the NE590N is priced at \$1.95 and the NE591N at \$2.45. Delivery is from stock from Signetics or its authorized distributors. For further information contact Signetics, 811 E. Arques Ave., P.O. Box 9052, Sunnyvale, CA 94086, (408) 739-7700.

CIRCLE INQUIRY NO. 269

### Equipment Protection

Lightning and heavy-duty electrical equipment often create power-line surges and transients. These can cause extensive damage to valuable microprocessors, peripheral equipment and business machines.



Electronic Specialists is introducing a line of AC wire-in transient suppressor/filters which will absorb repeated power surges, protecting delicate equipment. The filter section will greatly reduce power line hash.

Equipment Line Suppressor/Filter (10 amp load) price is \$16.50. For further information contact Electronic Specialists, Box 122, Natick, MA 01760.

CIRCLE INQUIRY NO. 275

### M68ADS-1A Autonomous Development System

The M68ADS-1A low cost keyboard-to-CRT stand-alone microprocessor development system is built around two basic modules — the M68SAC-1, an autonomous computer assembly, and the M68DIM-1A display interface.



These modules, in concert with the resident firmware MINbug II (MEC68MIN2) and Input/Output Supervisor (M68IOS-1), allow the user to debug both hardware and software. The M68KBD-1 Keyboard and M68MDM-1 monitor provide man/machine interfaces, while the optional M68CIM-1A Cassette Interface facilitates program storage and retrieval.

In addition to internal computing capacity devoted to MINbug II debugging, an I/O supervision routine, and 512 bytes of display character memory, ADS contains a user's section consisting of 256 bytes of RAM, 2048 bytes of AROM, and a PIA.

Price of the M68ADS-1A is \$1395 each. For further information contact Motorola Semiconductor Products, Inc., 5005 E. McDowell Rd., Phoenix, AZ 85008, (602) 244-6900.

CIRCLE INQUIRY NO. 271

### Complex Sound Generator Integrated Circuit

The SN76477N can be used to generate virtually any complex sound (siren, gunshot, jet engine, whistle, pinball sounds, etc.). This IC

can be used in a wide variety of products including games, toys, appliances, medical equipment and intelligent terminals.



The SN76477N contains a voltage controlled oscillator, a super-low frequency oscillator, a white noise generator, a noise filter, a one shot, a mixer and an attack/decay envelope generator.

The SN76477N is characterized for operation from -10°C to 40°C. It is offered in a 28-pin plastic DIP package. For more information contact Lowell Chambers, Texas Instruments, Inc., P.O. Box 84, M/S 812, Sherman, TX 75090, (214) 893-5166, Ext. 7837.

CIRCLE INQUIRY NO. 297

### Building Microcomputer Systems

The Integrand Model 800 Mainframe is a completely assembled and tested cabinet, motherboard, power supply combination. The 800 allows complete freedom in building a computer by supplying only the chassis unit — the user can choose complementary CPU, memory, and I/O cards to complete a system. By building a system in this way the user can save several hundred dollars over the cost of similar systems on the market.



IR offers various options for the mainframes. We also have supporting hardware for floppy disk systems and keyboards. The cabinets, power supplies and other system components are available separately.

Prices are: Model 800 (rack mount) \$200; Model 800D (desk top), \$235.

For more information contact Integrand Research Corp., 8474 Avenue 296, Visalia, CA 93277, (209) 733-9288.

CIRCLE INQUIRY NO. 274

### OP-07CP Operational Amplifier

The OP-07 Series operational amplifier is available in a rugged epoxy mini-dip package, making it possible for users to employ automated component insertion equipment to load this high performance device on printed wiring boards, at high speed.

Designated the OP-07CP Ultra-Low Offset Voltage Op Amp, it is capable of maintaining an input offset voltage below 250 microvolts over an ambient temperature range of 0°C to 70°C without resorting to an external timing potentiometer. Maximum long term input voltage drift, at 2.0 microvolts/month maximum, is also unusually low.

Mounted in an 8-lead, mini-dip dual-in-line package, the OP-07CP is a direct replacement for the 725, 108A/308A and OP-05 amplifiers. Also the OP-07CP can be used to replace 741

series devices by merely disconnecting the 741 nulling potentiometer.

In stock on distributors shelves, the OP-078CP Ultra-Low Offset Voltage Op Amp is priced at \$3.25 in quantities of 100 to 999. For more information contact Don Soderquist, Precision Monolithics, Inc., 1500 Space Park Dr., Santa Clara, CA 95050, (408) 246-9222, Ext. 183.

CIRCLE INQUIRY NO. 282

### New Indicator Knob

The Buckeye Stamping Company has expanded its matching instrument knob line with the addition of an indicator knob with an integral pointer.

This knob is precision molded of cyclocac (ABS) and features a prominent white stripe running vertically down the 1/16" molded pointer for quick indication. It is available in two sizes: 3/32" and 1/8" diameters, both 3/4" high. This new knob is offered in the three established Buckeye styles: Prestige (PS) featuring a spun aluminum anodized cap; Design (DSN) with an anodized inset; and Standard (SSN) with a recessed, pebble-finish top. A full series of concentric combinations is also available.



The cost range starts at \$.77 for 1 to 99 and at \$.51 for 1,000. Delivery time is two to three weeks. For further information contact The Buckeye Stamping Co., 555 Marion Rd., Columbus, OH 43207, (614) 445-8433.

CIRCLE INQUIRY NO. 287

### Octal Buffers

Working well with popular data widths of 8-, 16-, 24- and 32-bits, the buffers are well suited for high-speed PROM applications or wherever standard I/O buses are found.

The bipolar chips — designated SN54/SN74S240, S241, S244 — are second-sources for Texas Instruments' like-numbered standard Schottky TTL parts, and will be followed through first quarter 1978 with a family of 20-plus devices, including both Schottky and proprietary low-power Schottky versions.



Designed in 20-pin space-saving "Skinny-DIPs" the buffers sell for \$4.40 in plastic packages for 100-999 quantities; production lots are available in five weeks ARO.

For more information contact John Birkner at Monolithic Memories, 115 E. Arques Ave., Sunnyvale, CA 94086, (408) 739-3535, ext. 175; or Paul Plansky at Tyco-Fultz-Bellack, Palo Alto, CA, (415) 328-6300.

CIRCLE INQUIRY NO. 272

### LED Mounting Clip/Lens Combinations

LED mounting clip and lens combinations for use with T-1 3/4 LEDs are now available from Texas Instruments. Series TILM3 mounting



clips with reflecting lens considerably enhances systems with LEDs.

Available in a choice of red, yellow, green or clear plastic, the series is designed to reduce installation time for panel mounted LEDs. Installing the mounting clip requires no tools. It fits easily into a 1/4" panel hole and the LED can then be inserted from the back.

These clip/lens combinations provide an extra measure of secure mounting, eliminating problems of LEDs backing out into equipment. They also protect LEDs from mechanical shock and static electricity discharge.

For further information contact Texas Instruments Incorporated, Inquiry Answering

Service, P.O. Box 5012, M/S 308 (Attn: LED clip), Dallas, TX 75222.

CIRCLE INQUIRY NO. 268

### Register Has Standard and Three-State Outputs

Designated the Am25LS2518, this device offers typical clock-to-output delay of 18 nanoseconds. This is 55 percent longer than the high-speed Am25S18 version, but reflects a power savings of more than 75 percent.

The Am25LS2518 can be used in computer or computer peripheral equipment as an address register, a status register, an instruction

register or for various other data or microword register applications.

The function is expected to be alternate sourced by Texas Instruments as the 5474LS388.

Prices for the Am25LS2518 start at \$2.18 for the molded package in 100-unit lots. It is available nationally from Hamilton/Avnet, Schweber or Cramer and regionally from Arrow, Bell, Century, Future, Liberty/Elmar, RAE, Sheridan and Summit. For more information contact E. Sopkin, Advanced Micro Devices, 901 Thompson Pl., Sunnyvale, CA 94086, (408) 732-2400.

CIRCLE INQUIRY NO. 288

## Literature

### "Last Chance Filtration"

A new 24-page report entitled "LCF, Last Chance Filtration, Its Application in Fluid Systems," is now available from Mectron Industries, Inc. An LCF (Last Chance Filter) is a small, specially designed filter installed immediately upstream of a fluid system component (but downstream of the main system filter) to protect that component from catastrophic failure causing contaminant particles.



The publication, which describes in detail the construction, applications, and specifying of LCFs, will be of particular interest to engineers and designers of hydraulic and pneumatic systems and components. Included in the report are sufficient details about the characteristics and performance of LCFs to enable a design engineer to formulate a meaningful problem statement and specify a suitable Last Chance Filter.

To receive your copy of this report write to Mectron Industries, 9857 Remer St., So. El Monte, CA 91733. Ask for FSR 100.

CIRCLE INQUIRY NO. 301

### TWA Solves Small Package Shippers' Crisis

The "TWA Small Package Crisis Survival Kit" highlights the unique TWA "Next Flight Out" Small Package Express Service.

The main feature of the Survival Kit is a brochure detailing TWA's "Next Flight Out" shipping procedures, maximum package weight and dimensions, pick-up and delivery arrangements, ways to pay for the service and information on the "Next Flight Out" 100% money-back guarantee on service as promised.



The "TWA Small Package Crisis Survival Kit" is available to small package shippers by writing to "Next Flight Out," Trans World Airlines, Inc., P.O. Box 839C, Farmingdale, NY 11736.

CIRCLE INQUIRY NO. 299

### New Computer Warehouse Catalog A System Builders' Guide

The 1978 Catalog from Computer Warehouse (CW) is packed with data on 10 different microcomputers, cost-effective used peripherals, and descriptions of over 275 computer books now available for immediate delivery. Over 1,500 products are covered, both new and used, from over 170 different vendors.



Highlighting the catalog are detailed descriptions, hints on the best uses, and a complete comparison chart that covers the microcomputers currently available from CW: Southwest Tech 6800, IMSAI 8080, Processor Tech Sol 20, IASIS 8080, Olivetti P6060, Intersil Intercept Jr., Commodore KIM, RCA Cosmac, Motorola 6800 and National SC/MP.

The 1978 catalog is available for \$1 to cover 1st class postage and handling from CW. For further information contact Vic Farmer, Computer Warehouse, 584 Commonwealth Ave., Boston, MA 02215, (617) 261-1100.

CIRCLE INQUIRY NO. 298

### Robotics Newsletter

Here is a ground floor opportunity to reach a unique market, robot enthusiasts, at a dirt cheap price. IIR is introducing a new publication, Robotics Newsletter, oriented toward this heretofore neglected group. During the first three months of publication, January, February and March, classified ad rates are only 10¢ a word with a minimum of fifteen words. Three consecutive ads will get you a 10% discount.

Page size is 8 1/2 x 11 with trim page coming to 7 x 10. Display ads should be camera ready for black and white, interior screens: 85 line. Closing date is 30 days before first of month of desired issue for classified and display.

If your product is electronically or mechanically oriented, mathematically involved or just unusual, Robotics Newsletter is just the publication for you.

For more information contact The International Institute for Robotics, P.O. Box 615, Pelahatchie, Miss. 39145, (601) 854-5339.

CIRCLE INQUIRY NO. 319

### Instant BASIC

For the personal computer enthusiast or the user of DEC's BASIC PLUS language, there is a new book ready to teach you BASIC — Jerald Brown's *Instant BASIC*. *Instant BASIC* teaches BASIC to beginners, using interesting programming ideas and applications that will be easily understood by the home computer programmer. BASIC PLUS users know that the two languages are very similar, so this book can be used by them as well.



*Instant BASIC* is an "active participation" workbook, designed to be used with your home computer so you can learn by doing. Ideas are slowly introduced in a non-mathematical context so the beginner can quickly learn good programming techniques.

*Instant BASIC* is available for \$6.00 from local computer stores and bookstores. It is published by Dymax, P.O. Box 310, Menlo Park, CA 94025, (415) 323-6117.

CIRCLE INQUIRY NO. 316

### Computer Store Survey

The survey, which involved both questionnaires and telephone interviews, covers over 450 computer stores. The report shows how the computer stores rate the top 37 personal computer manufacturers on 17 performance parameters such as delivery, packaging, warranty, pricing and reliability.



The report also covers business problems, trends and market characteristics observed by the store managers.

This report is "must" reading for equipment manufacturers who want to improve their market position and for investors who want to avoid mistakes. For further information con-



tact Image Resource, 717 Lakefield Rd., Suite B, Westlake Village, CA 91361, (805) 495-6277.  
CIRCLE INQUIRY NO. 302

### Pocket Guide for Advertising/Marketing Managers

A slim line pocket guide which lists 70 electronic/computer publications, including address, phone number, publisher, key editors and sales people plus West Coast sales reps and editors, has been published by Courtney/Wilson Advertising.



Designed to save time for advertising, marketing and sales executives and agency people handling electronic accounts, this "At a Glance" booklet sells for \$10 per copy.

For further information contact Larry Courtney, Courtney/Wilson Advertising, 20969 Ventura Blvd., Suite 24, Woodland Hills, CA 91364.

CIRCLE INQUIRY NO. 313

### New DEC Brochure

A brochure describing Digital Equipment Corporation's new VAX-11/780 computer system is now available. The four-color, 24-page booklet explains the 32-bit VAX-11/780's operating strengths, software features such as the VAX/VMS virtual memory operating system, PDP-11 compatibility, hardware innovations and peripheral options.



To obtain a copy of the VAX-11/780 brochure request publication number EA 08782 from Communication Services, Digital Equipment Corp., 444 Whitney St., Northboro, MA 01532, (617) 897-5111, Ext. 2857, McLaren Harris.

CIRCLE INQUIRY NO. 304

### New Guide to Frequency Counters

A new brochure is now being offered by the B&K-Precision product group of Dynascan Corporation which describes in detail the company's full line of frequency counters.

The six page full-color brochure provides detailed information on frequency counter applications and important features. Four frequency counters are shown, including a 520MHz model which typically reads to 600MHz. The 1820 features not only frequency measurement but period, elapsed time and total events as well. For field service application, a battery-powered portable counter is also described. Very complete specifications for all of the frequency counters offered are included in the brochure. To facilitate easy comparison of features and specifications, a standard format is

used for all units. In addition, all specifications are conveniently grouped on a common page.

A broad selection of frequency counter accessories are shown including probes, power adaptors, carrying cases and an RF signal tap.

The new brochure is available free of charge at local B&K-Precision distributors or by requesting brochure BK-1800 from B&K-Precision, Sales Dept., 6460 W. Cortland Ave., Chicago, IL 60635, (312) 889-9087.

CIRCLE INQUIRY NO. 307

### Basic Self-Instruction Course

Heath Company has announced the introduction of its EC-1100 self-instruction course in BASIC language programming techniques. The course takes an approach which has been designed to teach even those with little or no computer experience the skills necessary to intelligently converse, create and program in the BASIC computer language.



Programmed instruction texts combined with practical demonstration programs and practice problems are employed in the EC-1100 course to teach BASIC language formats, commands, statements and procedures. In addition, the course goes one step beyond conventional courses and texts and gives the student a practical introduction to the creative and problem-solving aspects of programming in BASIC.

The EC-1100 is keyed to the Heath computer systems; however, because of the universal machine independent nature of the BASIC language, this course can be a supplement to any other computer systems using BASIC. The EC-1100 course is mail order priced at \$29.95. For a free catalog contact Heath Company, Dept. 350-450, Benton Harbor, MI 49022.

CIRCLE INQUIRY NO. 306

### Cramer Catalog

Cramer Division of Conrac Corporation has compiled a six-page, two-color catalog describing its timers available for off-the-shelf delivery from authorized Cramer distributors nationwide.



The catalog lists technical data for accurate timer selection and all necessary ordering information.

All products are shown in black and white photos. Included are reset interval timers, cycle timers, elapsed time indicators and solid state timers. A "Selection Chart" simplifies exact ordering of the cycle timer chassis, motor, and gear rack that will provide the switch poles and cycle time required.

For copies, write or call Mr. Everett Latour-ette, Cramer Div., Conrac Corp., Mill Rock Rd., Old Saybrook, CT 06475, (203) 388-3574.

CIRCLE INQUIRY NO. 309

### Minicomputer & Word Processing

Printcraft Systems, Inc., has published a four-page cross reference of compatible magnetic media supplies, used with minicomputers and word processing systems.

The reference lists less expensive, guaranteed compatible Diskettes, Cassettes, Mag Cards and Tapes, Data Cartridges, and Disk Packs, for virtually any system manufactured. Most products are shipped the same day as an order is received. Master Charge and Visa are accepted.

For brochure send a stamped, self-addressed envelope. For more information contact Don Hubbinett, Printcraft Systems, Inc., 11-17 Beach St., New York, NY 10013, (212) 966-0001.

CIRCLE INQUIRY NO. 300

### Catalog on New Solid State Timers

The Cramer Division of Conrac Corporation has prepared an eight-page, illustrated, two-color catalog describing their line of solid-state timers.



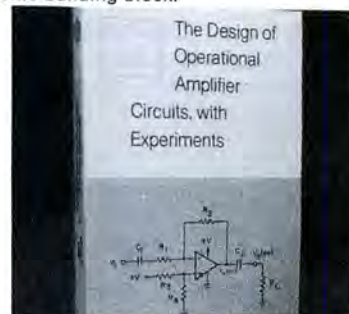
The booklet lists complete technical data on all 21 stock versions of U.L. approved timers. This includes: "on" delay, extended "on" delay, "off" delay, interval and repeat cycle timers. Photos, dimension drawings and wiring diagrams for each version are included in the specifications. Total ordering information is presented in a table format, which identifies time ranges for each of the five basic configurations.

For copies, write or call Mr. Everett Latour-ette, Cramer Div., Conrac Corp., Mill Rock Rd., Old Saybrook, CT 06475, (203) 388-3574.

CIRCLE INQUIRY NO. 310

### Sourcebook on Operational Amplifiers

*The Design of Operational Amplifier Circuits, with Experiments* by Howard M. Berlin, published by E & L Instruments, Inc., explains the design and operation of the important and versatile op amp. This sourcebook combines text with experiments to aid the reader in understanding the fundamental principles of this linear circuit that is such a useful electronic building block.



This sourcebook on operational amplifiers is especially valuable for the beginning experimenter or hobbyist who wants to learn by self-study. It is also an excellent supplemental text for college level lab courses on linear integrated circuits because of its comprehensive treatment of the subject.

*The Design of Operational Amplifier Circuits, with Experiments* is priced at \$8.50 and is available from E & L Instruments, Inc., 61 First St., Derby, CT 06418, (203) 735-8774, and its representatives.

CIRCLE INQUIRY NO. 303



## Wang's MMS

A twelve-page black and white brochure on Wang's *Manufacturing Management System* is currently available from Wang Laboratories.



Featuring a bill of materials processor, integrated inventory control, complete order and inventory analyses, and full accounting capabilities, the Manufacturing Management System maximizes control and minimizes expenses in the areas of manpower, machinery, materials and money. Order from Wang Laboratories, One Industrial Ave., Lowell, MA 01851.

CIRCLE INQUIRY NO. 312

## Software Marketing Guide

Entitled "How to Package & Market Your Own Software Product — and Make It Go!", this booklet covers areas such as 22 proven ways to reach your marketplace, 12 reasons why software houses wind up in the dead heap, market research—how to test before you invest, the market hotbeds today, the best software advertisements ever written, what it takes to measure up as a software vendor, shoe-stringing your product to success, using distributors and reps, getting financing, patents, copyrights, and much more.

It's a straight-out reference of factual how-to-do-it information that will benefit everyone from the user with a software development investment to recoup, to the neophyte entrepreneur, to the established software vendor.

Extremely candid, it discusses what "The Coming Shakeout" really means, lays out a hard, "blow-by-blow" comparison of independent reps versus your own direct sales people, covers 32 items that users look for in software packages, including the "not-so-common" contract commitments the vendor may be asked to make.

The guide cost \$28.00, has 171 pages in an attractive 9 x 12 ring binder, and can be purchased with a check, BankAmericard/Visa, Master Charge, or company purchase order. Prepaid and credit card orders will be shipped postage paid, and for faster service to credit card customers orders may be telephoned in, (312) 945-2940. All Datasearch products carry a thirty day full refund policy.

For information or to order contact Datasearch, Inc., 730 Waukegan Rd., Suite 108, Deerfield, IL 60015.

CIRCLE INQUIRY NO. 305

## Transportation Concepts

An in-depth technical report, which serves as a guide for financial, data processing and transportation managers in solving their respective company's freight payment problems, is being offered by Transportation Concepts and Services (T.C.S.), Inc., recognized as a systems' authority in the freight rate audit and payment field and has installatins in major corporations.

Solving the "Freight Payment Problem" is an analysis of successful industry-applied methods, all of which are economically and technically feasible. It includes a comprehensive description of levels of solutions developed by shippers, service bureaus, and T.C.S.'s own freight technicians and computer experts.

This comprehensive publication is available at a cost of \$25.00 each, which includes hand-

ing and mailing. To order, send check or money order (no COD's, please) to Transportation Concepts and Services, Inc., 20 Highland Ave., Metuchen, NJ 08840.

CIRCLE INQUIRY NO. 308

## Microprocessor Interfacing Techniques

From Keyboard to Floppy Disk

One or multi-card implementations of microprocessor interfaces are becoming obsolete: one-chip LSI components plus software may now be used. Interfacing has been simplified by the new LSI components and related software techniques to the point where an electronics background is no longer required to build a system.



The book takes you through the complete assembly of a microprocessor system: *assembling a CPU; Input-Output techniques; interfacing to a keyboard; LED, teletype, printer, floppy disk, CRT, cassette-tape; Industrial interfacing; analog-to-digital techniques; Communications; Bussing and standards, including S100, IEEE488, CAMAC.* A complete case-study is presented for a multi-channel communication system and a chapter is dedicated to troubleshooting techniques. Actual interconnects are presented for a number of microprocessors, and, in particular the 8080 and the 6800.

For more information or to order, refer to Reference Book C207, Sybex, 2161 Shattuck Ave., Berkeley, CA 94704, (415) 848-8233.

CIRCLE INQUIRY NO. 327

## Industrial Control Brochure

A brochure describing Digital Equipment Corporation's new IP300 industrial control microcomputer system is now available. The publication discusses operational advantages, hardware features and system software of the IP300, a low-cost, LSI-11-based system for dedicated applications in industrial process monitoring and control.



The pamphlet contains a configuration summary listing standard systems, options, and both digital and analog I/O modules. To obtain a copy, or for more information, refer to brochure EA 08350 47 to Communication Services, Digital Equipment Corp., 444 Whitney St., Northboro, MA 01532, (617) 493-3716, Joseph Nangle.

CIRCLE INQUIRY NO. 325

## Computer Directory

Computer shopping? *The Computer Data Directory* announces the first edition of its comprehensive catalog for small computer users. Now, from several hundred computer related firms, you can choose products and services from the largest list ever printed.

Included are brand name manufacturers of

systems, peripherals, and accessories. In software, find who handles languages, business applications, household control, games galore, even custom programming services! Miscellaneous includes where to find books, magazines, newsletters, home study courses, data banks, tools, and repair services. Computer stores and clubs are indexed geographically.

The Spring '78 Directories will be available in early March; Only \$5.98 postage included. Send check or money order to: The Computer Data Directory, P.O. Box 598, Cleveland, OH 44107.

CIRCLE INQUIRY NO. 314

## Matrox Microprocessor Display Interfaces

This new brochure provides an introduction to a broad line of innovative microprocessor display interfaces.

The Matrox product line is divided into three main categories: including video RAM type alphanumeric microprocessor to TV CRT interfaces; graphics CRT controllers with resolutions from 256x256 to 512x512; and the alpha chip family of single chip LED alphanumeric keyboard/display controllers.



These state of the art OEM devices come as complete off the shelf, ready to use sub-systems (single chips, modules, PCBs). Matrox also offers many products which are plug-in compatible with industry standard buses including DEC LSI-11, Intel SBC-80, S100 bus and Pro-log.

The brochure includes descriptions and tables summarizing the physical and electrical characteristics of each member of the family. Detailed data sheets and applications notes are also available upon request. For copies of this brochure contact Matrox Electronic Systems, P.O. Box 56, Ahuntsic Stn., Montreal, Quebec H3L 3N5, (514) 481-6838.

CIRCLE INQUIRY NO. 311

## FRP Industry Report

The fiber glass-reinforced plastics (FRP) industry will consume more than one billion pounds of glass fiber reinforcements and almost two billion pounds of polyester resins by 1981, according to a new Owens-Corning Fiberglas Corporation publication.

The FRP industry report, *Productivity Update*, attributes this projected 80 percent increase to rapidly expanding new markets requiring light weight, corrosion resistance and energy efficiency.

Using fiber glass-reinforced thermoset polyester manufactured to tolerances of plus or minus .0005 inch per inch in a transfer molding process, Rostone Corporation, a Lafayette, Indiana, custom molder, consolidated and upgraded the complex computer base unit for Memorex Corporation's 550 Flexible Disc File. Because of material and process economies, the part can be manufactured at 80 percent of the cost of a comparable metal casting.

For further information, or a copy of *Productivity Update*, contact X.C. Meeks, Owens-Fiberglas Corporation, Fiberglas Tower, Toledo, OH 43659.

CIRCLE INQUIRY NO. 326



## Your Home Computer

A comprehensive user's guide, *Your Home Computer* by James White is an introduction to the world of personal microcomputing. Written in clear and understandable language, this book tells you everything you want to know about home computing and gives the computer novice a painless introduction to microcomputer technology and terminology, beginning with what computers are and how they work. This basic book requires no prior knowledge or experience in electronics or computing.



The book is available for \$6.00 from local computer stores and bookstores. Published by Dymax, P.O. Box 310, Menlo Park, CA 94025, (415) 323-6117.

CIRCLE INQUIRY NO. 315

## Three New Books

*Step by Step Introduction to 8080 Microprocessor Systems* by David Cohn and James Melsa is designed to show the microcomputer hobbyist how to put together systems and applications that really exploit the capabilities of a microprocessor. Paperback book, price \$7.95.

*Take a Chance with Your Calculator* by Swedish author Lennart Rade opens up the worlds of probability and of programmable calculators even for readers who have no previous experience either in probability theory or programming. Paperback book, price \$8.95.

*Beginning BASIC* by Paul Chirlian is an introduction to BASIC for beginners, written in response to the author's children's need for a really basic BASIC. It was designed for the person who has essentially no experience with computer programming. It is both elementary and complete. Paperback book, \$9.95.

For more information contact dilithium Press, P.O. Box 10766, 30 NW 23rd Pl., Portland, OR 97210, (503) 243-1158.

CIRCLE INQUIRY NO. 323

## Base Conversion Table

For the programmer who is tired of having to convert from one number system to another, Compac presents the Base Conversion Table. This table allows the programmer to instantly look up the representation of a number in a different base. The table contains the numbers 0 through 255 tabulated in five different number systems; binary, octal, decimal, hexadecimal, and two's complement.

The Base Conversion Table is printed on both sides of a high quality, heavy white stock. The table comes pre-punched with 3 holes, for permanent placement in your notebook, readily available for day-to-day use.

For more information contact Compac, P.O. Box 18470, Cleveland, OH 44118.

CIRCLE INQUIRY NO. 320

## Small Business Configurations

"Distributed Datasystems With DICAM," a new brochure from Digital Equipment Corporation, discusses operation of Digital's Datasystem 300 series small business computer systems in distributed processing configurations. DICAM (Datasystem Interactive Communications Access Method) permits easy communication between Datasystems and non-Digital host systems.

The pamphlet outlines advantages of using DICAM in credit checking, inventory control and sales estimating, and describes file utilities, forms handling and other software tools. To obtain a copy, request "Distributed Datasystems With DICAM" from Public Relations Dept., Commercial Products Group, Digital Equipment Corp., Merrimack, NH 03054.

CIRCLE INQUIRY NO. 324

## Beckman Catalog

A new, 16-page Short Form Catalog, "Planar Gas Discharge Displays and Accessories," consists of six sections tracing the history of PGD displays and describing raised cathode PGD displays, screened image displays, self-contained display modules, custom configurations and subassemblies, and accessories such as voltage converter, decoder/driver, connectors and pin straighteners.

For a copy of the Short Form Catalog contact Beckman Instruments, Inc., Information Displays Operations, 350 N. Hayden Rd., P.O. Box 3579, Scottsdale, AZ 85257.

CIRCLE INQUIRY NO. 317

## Brochure on Frako Electrolytic Capacitors

Tradeline, Inc. of New York City has available a new six-page technical brochure on the Frako line of aluminum electrolytic capacitors. Described in the publication are electrolytic capacitors in both axial and radial types, for general purpose, industrial and professional applications.

A copy of this brochure, in English, can be obtained free. Contact Tradeline, Inc., 1 World Trade Center, Suite 1829, New York, NY 10048, (212) 938-0930.

CIRCLE INQUIRY NO. 322

## Index for Computerists

The January-December 1977 Periodical Guide for Computerists indexes over 2200 articles from 25 hobby and professional electronic and computer publications. Articles, editorials, book reviews and letters from readers which have relevance to the personal computing field are indexed by subject under 100 categories. An author index is included which lists the subjects that each author wrote about.

The more than 60 page book is available postpaid for \$5.00 from E Berg Publications, 1360 SW 199th Ct., Aloha, OR 97005, or from local computer stores.

CIRCLE INQUIRY NO. 321

## Display Prototype Sheet Aids Designers

A 9 x 12-inch, adhesive-backed sheet allows designers to simulate full-size planar gas discharge displays for clock and front panel readouts. Printed in neon orange on a black background, PGD letters, numbers, and symbols in several font styles for 1/2- and 1-inch characters are practical aids for mock-ups.

For more information contact Beckman Instruments, Inc., Technical Information Section, Information Displays Operations, 350 N. Hayden Rd., P.O. Box 3579, Scottsdale, AZ 85257, (602) 947-8371.

CIRCLE INQUIRY NO. 318

# Software

## Micro-Label System

The Micro-Label System is a general purpose label printing product for mailing, inventory bin and similar types of labels. The label system is designed to run on dual North Star mini-floppy™ disk drives and an 8080 or Z80 processor with 20K bytes of memory.



Four programs provide a complete, random file maintenance process that includes addi-

tions, changes and deletions; sorting and master file comparison. The print program allows the user to specify the label width as well as the number of labels across the page. Two general purpose utility programs, a file copy and a file read and display, are provided to aid in the maintenance and upkeep of any North Star BASIC data file.

The standard Micro-Label System software is available for \$500 from Tylog Systems, Inc., 9805 SW 152 Terrace, Miami, FL 33157.

CIRCLE INQUIRY NO. 355

## DEBBI™

Disk Extended BASIC by iCOM, DEBBI, language system is being marketed as part of the iCOM® Microperipherals® product line by some 70 iCOM dealers across the country.

DEBBI has the easy-to-use algebraic structure and interactive nature of standard BASIC, but includes a number of features that make it even more powerful.

DEBBI permits either loading of a program from a disk or writing of a program to a disk by file name. Also, data may be read into a named variable from a specified disk file or data may

be written to a specified disk file from a named variable.

Random access to any disk sector for read and/or write may be accomplished with a user routine using a relocatable disk-handler routine supplied with FDOS-III.

DEBBI's string manipulation functions allow the processing of alphanumeric strings up to 255 characters long. String length is variable and need not be declared explicitly.

For more information contact Neil McElwee, Pertec Computer Corp., Microsystems Div., 21111 Erwin St., Woodland Hills, CA 91367, (213) 999-2020.

CIRCLE INQUIRY NO. 351

## Ed-Pro

Ed-Pro, Inc., formed to publish microcomputer software and instructional materials, offers a series of programs for the Heathkit H8 computer. Programs are recorded on tape cassettes ready for immediate use and are supplied with complete program listings and user instructions. Two tapes, selling for \$20 each (with a 10% discount if both are purchased) are currently available. One of them contains a collection of eleven game programs, while the



other contains personal finance programs for checkbook reconciliation, budgeting, and calculation of interest for various kinds of loans and investments.

For further information contact Jim Clark, Ed-Pro, Inc., 6580 Buckhurst Trail, Atlanta, GA 30349.

CIRCLE INQUIRY NO. 353

### Computer Chess

A computer chess program for 8080 and Z80 based microcomputers, this assembly language conforms to all rules and conventions of tournament chess including castling, en passant captures, and promotion of pawns. The entire program, including I/O routines, will run in 8K of RAM.

The user selects one of two board sizes for display, large for 24x80 CRTs or small for TVTs and teletypes. A level of difficulty between 2 and 5 is selected which determines how well the computer will play, with a level of 3 playing an average game. The program is self-initializing, eliminating the need to reload after each game. Both the user's and computer's moves are displayed in standard chess notation.

For users with a North Star disk system, the program is available on disk and uses the DOS I/O routines. The program is also available on paper tape with a 256-byte block reserved for the user's I/O routines. Instructions are provided for loading the program and patching the I/O routines.

The standard starting addresses are 2A00H for disk and 0000H for paper tape. Other starting addresses are available on request at no extra charge. The program is available in either form for \$35 at computer stores or from Software Specialists, P.O. Box 845, Norco, CA 91760. (Calif. residents add 6%).

CIRCLE INQUIRY NO. 340

### DECAL Language

Digital Equipment Corporation has a new release of its DECAL software system for instructional applications. DECAL Version 2 contains language extensions that permit creation of simulation and gaming exercises, and offers increased flexibility in student response-checking and lesson branching.

The license fee for DECAL Version 2 with full support is \$1,000. The system is available for current delivery. For additional information contact Digital Equipment Corp., Maynard, MA 01754, (617) 493-2857, McLaren Harris.

CIRCLE INQUIRY NO. 344

### Cromemco FORTRAN IV

Cromemco's FORTRAN IV is an ANSI standard FORTRAN X3.9-1966 package which provides new capabilities for users of Z-80 based microcomputer systems. Microcomputer users can now take advantage of the large number of applications already written in FORTRAN.

Cromemco FORTRAN IV is unique in that it provides a microprocessor FORTRAN development package that generates relocatable object modules and that is compatible with Cromemco's relocatable assembler format. Thus only the subroutines and system routines required to run Cromemco FORTRAN IV programs are loaded before execution. Subroutines can be placed in a system library so that the user can develop a common set of subroutines that are used in his programs. Also, if the user changes only one module of a program, only that module needs to be re-compiled.

Cromemco FORTRAN operates as part of CDOS, the Cromemco disk operating system, and is available on either 5" or 8" floppy disk. For Cromemco system customers, FORTRAN IV is available for only \$95.

For additional information contact Cromemco, Inc., 2400 Charleston Rd., Mountain View, CA 94043, (415) 964-7400.

CIRCLE INQUIRY NO. 346

### New Data Management System

INFORM is an all-purpose data management system that features flexibility and easy operation, while significantly reducing user programming costs.

The program is offered exclusively by United Computing Systems. INFORM is available either in-house, on the DEC PDP 11-70 minicomputer; or in the time-sharing mode, through United Computing's 140-city UNINET communications network.

Designed to perform the entire range of data processing functions, INFORM may be operated by expert or novice with equal ease. A series of simple commands, in basic English, permit data entry, verification, retrieval, manipulation, sorting and reporting, allowing non-programmers to make use of the system with minimal instruction.

Typical INFORM applications have included general ledger audit systems; mass production reporting, analysis and scheduling systems; and budget planning and tracking systems.

For additional information on INFORM contact Jack Kelly, product manager, United Computing Systems, 2525 Washington, Kansas City, MO 64108.

CIRCLE INQUIRY NO. 330

### Powerful Name and Address Select and Letter Writing Software

Written in North Star BASIC, this set of commercial grade software is in production use for direct mail to selective customers applications. It is an excellent way to keep track of customers, prospects or vendors.

Each master record contains a special code that can be used to describe any characteristic. The software allows selection based on code, sorting, merging with selective letters for printing, 4-up label printing or combination of the above. Current users include insurance agents, a purchasing department of a large corporation, a heavy equipment broker, and a home builder.

For more information contact The General Computer Co., 420 Main St., Brighton, MI 48116.

CIRCLE INQUIRY NO. 357

### PDP8 X8 Cross Assembler Series

Sierra Digital Systems has added four new microprocessor cross-assemblers to its X8 cross-assembler series for the DEC PDP8 minicomputer. The X8 series cross-assemblers now cover the Z80, 1802, SC/MIP and 8048 microprocessors in addition to the previous 6502, 6800, 8080, F8 and 2650 versions.

All X8 series cross-assemblers are immediately available. Each cross-assembler is priced at \$400 and distributed in PDP8 binary format on paper tape, Dectape, or Dec floppy diskette. Source files are also available for an additional \$250. For more information contact Sierra Digital Systems, 13905 Rancheros Dr., Reno, NV 89511, (702) 329-9548.

CIRCLE INQUIRY NO. 349

### Timesharing Tiny BASIC

Timesharing Tiny BASIC (TTB) is a version of Tiny BASIC enhanced for real-time processing and written for use with the Better Bug Trap board in an S-100 system. TTB will support many terminal users limited in number only by the size of available memory. In addition, any number of background programs may be active independent of any terminal. Thus, a number of different real-time tasks may be written independently and run simultaneously without interaction. Memory and I/O ports are manipulated as arrays. Any variable may be used as 16-bit array. Fast and easy real-time programming is thus possible in a high level language.

TTB on paper tape with relocating loader is \$25 with the purchase of a Better Bug Trap. For

more information contact Micronics, Inc., P.O. Box 3514, Greenville, NC 27834.

CIRCLE INQUIRY NO. 354

### EMPL/8080 Interpreter

EMPL is a popular, easy-to-learn micro version of APL for the Intel 8080. It resides in the first 5,632 bytes of memory. EMPL has numeric and character vectors, user-defined niladic, monadic and dyadic functions, 22 primitive functions, 9 system commands, and many other special operators and characters.

EMPL is \$10 on Tarbell cassette; \$20 on paper tape, North Star Disk, CUTS cassette, or MITS cassette. Ask about EMPL on other media.

Order from Erik T. Mueller, Britton House, Roosevelt, NJ 08555, (609) 448-2605.

CIRCLE INQUIRY NO. 352

### WHIZ™

WHIZ is a software program for recording and loading MC6800 based programs on the SWTPC M68 computer with MIKBUG and the SWTPC AC-30 cassette interface. WHIZ operates at nine times the standard MIKBUG format 300 baud speed and three times that of the binary format. This higher speed capability is provided without any modifications to the standard computer or AC-30; just load and go. Load a 1K program in 14 seconds, 4K in 48 seconds, and 8K BASIC in 85 seconds.

WHIZ includes an interactive front-end which allows the specification of a header and program start address to be placed on tape for read-back later.

For \$15.95, WHIZ is supplied on Kansas City standard cassette in MIKBUG format and includes a built-in relocater to place your own copy of WHIZ in RAM memory wherever you wish. WHIZ is optionally available in 2708 EPROM. For further information contact Shifting Sands Microcomputer Products Corp., P.O. Box 441, Fairborn, OH 45324.

CIRCLE INQUIRY NO. 356

### OS-WP1

The OS-WP1 is a full text editor which operates at both the character and line levels. It has its own internal GET and PUT file commands which transfer individual files from memory to disk by typing the appropriate command. A total of 209,000 characters can be stored on a diskette. The OS-WP1 has a full set of printer control commands which can be used with virtually any impact or matrix computer printer or word processing printer. The formatted output mode allows the user to perform left and right justification of text without line numbers at a designated width of from 20 to 70 characters.

The complete Word Processor package, two diskettes and a manual is available for only \$79 for use on any disk-based Ohio Scientific computer system. For additional information contact Rob Spademan, Ohio Scientific, Hiram, OH 44234, (216) 569-7905.

CIRCLE INQUIRY NO. 342

### Version 3.0 of Super BASIC

Version 3.0 of Super BASIC, a 12K BASIC interpreter, up-grades and supersedes Version 2.1 with numerous speed and error handling features.

Version 3.0 of Super BASIC provides programmable error handling that allows the user to specify special error handling routines processing any error occurring in the basic program without aborting the program.

Version 3.0 is relocatable and uses the monitor's operating system for its I/O handling. It comes with the user's manual and occupies 12K of core. Although primarily designed to run on TDL's Z80™ microcomputer system, it is adaptable to other Z80™ based systems. Super BASIC Version 3.0 is on a diskette and is a part of TDL's Software Package A which consists of Version 3.0, The Macro Assembler 2.2, Z-TEL Text Editing Language



and the Text Output Processor. This entire package is available for \$249.

For further information contact Barbara Greenbaun, Dir. of Public Relations, Technical Design Labs, Research Park, Bldg. H, 1101 State Rd., Princeton, NJ 08540, (609) 921-0321.

CIRCLE INQUIRY NO. 338

### A Family of Multi-Tasking Operating Systems

Industrial Programming's real-time, multi-tasking operating system is available for the 8080 (MTOS-80), 6800 (MTOS-68), and PDP-11 (MTOS-11). Each of the MTOS systems requires about 3,000 bytes of storage.

MTOS performs the following general services: Activation of the highest priority ready task; automatic activation of a user task upon startup (power on); automatic activation of an alternate user task upon receipt of an external "re-initialize" signal.

The following services are provided in response to specific requests from a task: Start another task if that task is dormant; start another task and queue the request if that task is busy; pause for a given time interval; cancel pause of another task; wait until internal coordination flags are set; set, reset, or test coordination flag; enter shared subprogram; read or write console message; read or write external discrete signal; terminate task with or without automatic restart after given time interval.

Detailed User's Guide available for \$10 each. Price for MTOS-80, MTOS-68 and MTOS-11 in source language form is \$1,750 each. For further information contact Industrial Programming, Inc., 9 Northern Blvd., Greenvale, NY 11548, (516) 621-8170.

CIRCLE INQUIRY NO. 335

### CICS-Type Operating System

A new comprehensive CICS-type multi-tasking, multi-user operating system is now in use on the IBM/SERIES/1 minicomputer. SPUTNIC is a mini-based CICS-type processor with capabilities similar to IMB's CICS teleprocessing monitor.

abilities similar to IMB's CICS teleprocessing monitor.

SPUTNIC functions as a disk resident operating system; is totally macro driven and provides application programmers with the facility to develop sophisticated real-time systems in a device independent environment.

SPUTNIC is available with both lease and purchase arrangements. For further information contact Jones Health Systems Management, Inc., 745 Fifth Ave., New York, NY 10022.

CIRCLE INQUIRY NO. 334

### SMAL/80

SMAL/80 is a compiled, structured, macro-assembly language for 8080 and 8085 microprocessors that requires only 7K of memory.

The SMAL/80 package includes a 2K macro preprocessor written in SMAL/80 that greatly extends the usefulness of the language. The macro preprocessor permits conditional expansion of statements, unlimited nesting of macros, and has a natural notation that is conducive to efficient, error-free programming.

SMAL/80 is being offered initially on CP/M and Isis I disks. Price, including documentation is \$75.00. For details write CHROMOD Associates, P.O. Box 3169, Grand Central Station, New York, NY 10017.

CIRCLE INQUIRY NO. 339

### NUTRIVALUE™

Consultus is marketing nutritional analysis software for personal computers. The NUTRIVALUE programs enable users to analyze recipes, meal plans, and daily or weekly menus on their home computers. The analysis is computed from the list of ingredients and is printed (or displayed) in tabular form.

The NUTRIVALUE software is available under license from Consultus. NUTRIVALUE I is furnished in listing form (\$10.00) or on 8-level ASCII paper tape, plus listing (\$13.00). NUTRIVALUE II with the 100-item data base comes as listings (\$30.00) or on paper tape or cassettes

(\$35.00). With the 200-item data base, the NUTRIVALUE II prices are \$40.00 and \$45.00 respectively. For those who order NUTRIVALUE II with the 100-item data base and later wish to upgrade, the second hundred items are available as an expansion data base for \$15.00 in listing form and \$20.00 on paper tape or cassettes.

For further information contact Louise L. Silver, Consultus, P.O. Box 86, Arlington, MA 02174.

CIRCLE INQUIRY NO. 347

### The 6502 Program Exchange

The 6502 Program Exchange has released a number of software packages for 6502 systems. These include an extended version of the high-level language FOCAL, a 4K resident assembler, and an efficient Mini-Editor.

The FOCAL is called FCL65E (6.5K) and offers 8 to 9 digit accuracy, 8-level priority interrupt handling, string variables and functions.

A Mini-Manual (\$6) and a paper tape or hex dump (\$17) will get you started on TIM or KIM systems. A User's Manual, 104 pages of FCL65E examples and further documentation is available for \$12.

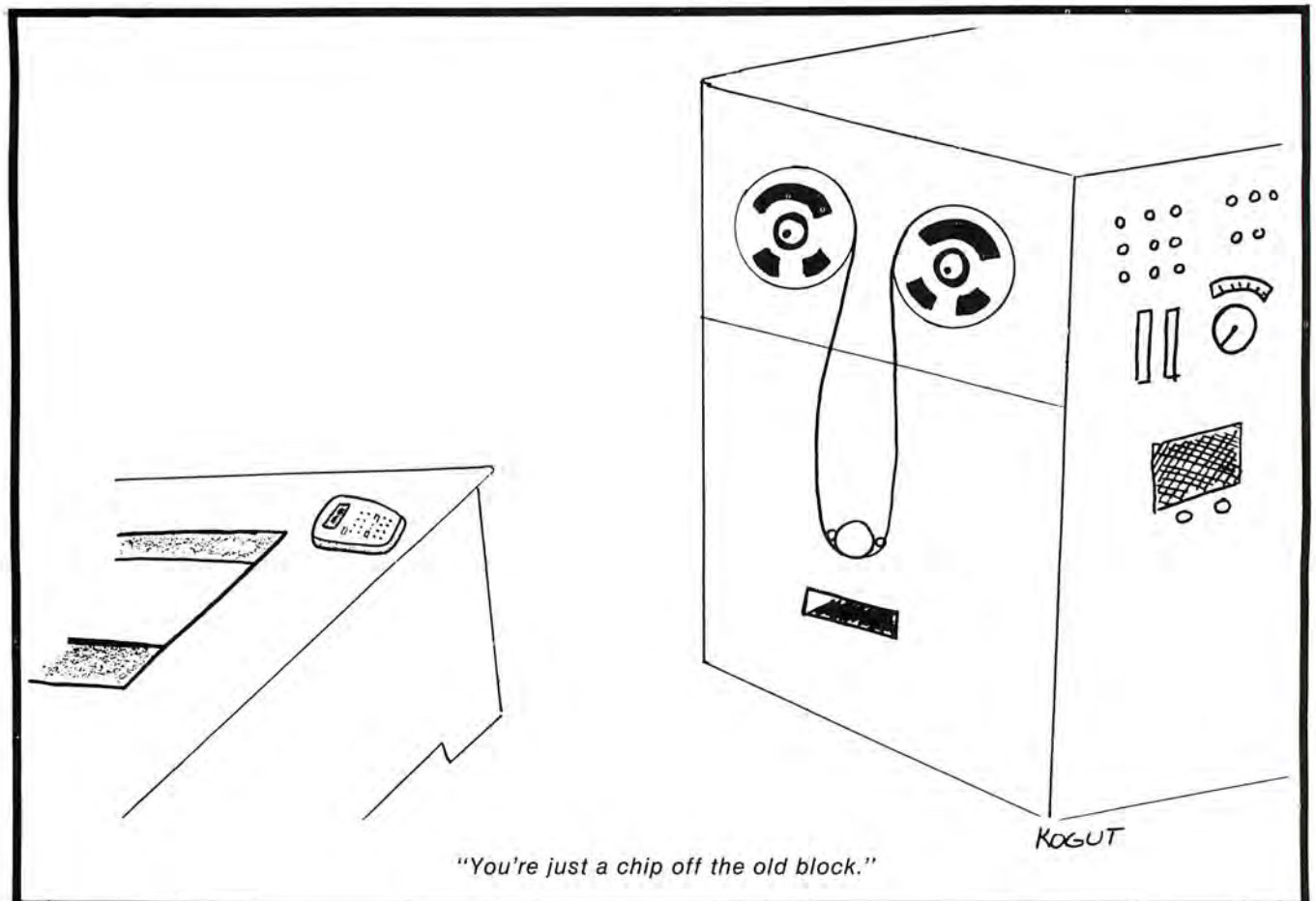
For more information and a list of other available software send \$1.00 to The 6502 Program Exchange, 2920 Moana, Reno, NV 89509.

CIRCLE INQUIRY NO. 341

### CP/M on North Star Disk

Now North Star Disk users can also join the software bus. Without any hardware changes, CP/M can be run with all the features available to the users of the system on standard floppy disks. Microsoft FORTRAN-80 and Disk Extended BASIC can also be supplied on 5¼" diskette to run on "CP/M on North Star Disk." All the software is fully 8080/Z80 compatible. Retail prices: CP/M on North Star Disk, \$112; FORTRAN-80, \$400; Disk Extended BASIC, \$300.

For more information or to order contact





CIRCLE INQUIRY NO. 328

### Computerized Printing System

AFCAD, the advanced computerized documentation composition and printing system, enables typists and secretaries to use their company's computer to prepare letters, sales reports, engineering manuals, new business proposals, and many other documents.

The system is a major development in computer applications, providing a low cost method for document preparation while substantially increasing personnel productivity. This AFCAD system is similar to current methods of layout and printing used by all up-to-date newspapers. AFCAD is available on a long term lease to all companies concerned with cost reduction and improving the quality and accuracy of their publication paper work.

For further information contact Kirby Computer Systems, Inc., 1944 Washington Valley Rd., Martinsville, NJ 08836, (201) 469-6000, Conrad Schilling.

CIRCLE INQUIRY NO. 333

### FDOS III

The Floppy Disk Operating System, FDOS-III, is a new flexible, powerful system for microcomputers.

The new system has a relocatable assembler for 2-80 and 8080 code to provide maximum flexibility and power. Also, all console communications are in decimal or hex for ease of program development. "BATCH" command allows automatic chain operations, and the system includes an optional operator prompt feature for variable input requirements.

The new system is fully compatible with programs written under iCOM's FDOS-II and allows immediate use of any existing iCOM-compatible programs. It also has relocatable driver modules which allow easy access to files for maximum data handling flexibility. A string-oriented text editor makes file or program modification fast and easy.

For more information contact Neil A. McElwee, Pertec Computer Corp., Microsystems Div., 21111 Erwin St., Woodland Hills, CA 91367, (213) 999-2020.

CIRCLE INQUIRY NO. 332

### Inventory-1

Inventory-1 is an interactive inventory control system for S-100 bus microcomputers. The system is designed to run on Shugart Minifloppy™ drives, and provides three second access to any item in the inventory file. Unique "HELP" and "EXPLAIN" commands permit even first time users to quickly build and maintain a detailed inventory system.

An integral part of Inventory-1 is a set of "skeleton" programs which can be used to implement special user defined commands. Using a "skeleton" program, it is possible to produce the software necessary to generate a special report in less than five minutes. Price is \$99.95; delivery is 48 hours ARO.

Two additional software packages, Inventory-2 and Inventory-3 have file structures compatible with Inventory-1. Inventory-3 features multi-level bill of material explosions.

For further information contact The Software Works, Inc., P.O. Box 4386, Mountain View, CA 94040.

CIRCLE INQUIRY NO. 331

### Data Base Management System Called "Manage"

Business managers can easily assemble information for decisions and generate complex reports from more than 60 data files with Manage, a data base management system available on Infonet, Computer Sciences Corporation's remote data processing service.

Manage is Infonet's most powerful offering to date in data base management. It enables a

company to create sophisticated information systems that draw upon multiple sources to fulfill information needs at all levels of the organization.

Infonet customers may purchase disk storage in blocks of 2,000 pages each. Such block purchases can result in reductions of more than 60% from storage costs based on standard page-per-day pricing.

For more information contact Computer Sciences Corp., 650 N. Sepulveda Blvd., El Segundo, CA 90245, (213) 678-0311, Jim Furlong.

CIRCLE INQUIRY NO. 348

### MCS 6502 Resident Assembler/Text Editor

The ASSM/TED resides in less than 4K of RAM or ROM type memory (0200-1200, 0400-1400, 1000-2000, 2000-3000, please specify version desired). Syntax very similar to MOS technology. Produces relocatable object code on tape (with checksum) and can store directly executable code in memory during assembly. Using the relocating loader program, one can reload relocatable object code at practically any location.

This software supports up to 2 tape decks, CRT and keyboard, and an optional printer. HEX listing of ASSM/TED and relocating loader, and operators manual, \$25. Contact C.W. Moser, 3239 Linda Dr., Winston-Salem, NC 27106.

CIRCLE INQUIRY NO. 329

### CP/M™ Macro Assembler (MAC)

A macro assembler, called "MAC," operates with the Digital Research standard CP/M Diskette Operating System and implements the redefined Intel standard macro facility, while retaining upward compatibility from previous standard assemblers.

Documentation includes the "MAC Macro Assembler Language Manual and Applications Guide," which is a complete text on the use of macro facilities for microcomputer software design. Applicable to both the Digital Research and Intel macro assemblers, this manual contains several complete examples of microcomputer applications, including traffic light and machine tool control, machine instruction emulation, program control structures, and operating systems interfacing for data file management (170 pages).

The diskette containing the macro assembler (machine code only) is available with the documentation for immediate delivery at the price of \$70 (diskette order must be accompanied by the purchaser's CP/M serial number). The documentation is available separately for \$15 (no serial number required), with the option of later diskette purchase at \$60. For more information contact Digital Research, P.O. Box 579, Pacific Grove, CA 93950, (408) 373-3403.

CIRCLE INQUIRY NO. 337

### North Star Software

MAILLIST is a general purpose mailing label program. It is capable of producing formatted lists for tractor-fed or Xerox type labels. Maillist will also sort lists for any field, name, address, city, state or zip.

Maillist has a search mode that will search any chosen field for a string and then display it. The use of search will expedite assembly of specialized mailings to different areas.

Price is \$39.95 on diskette with manual. Delivery is stock to 14 days.

DOS IN-OUT DRIVER is designed to set up mapped memory video boards in conjunction with a hard copy device. The user can switch output under software control. Any file directory can be listed while in BASIC without jumping to DOS. Spacebar will stop output for line-by-line listings. Nulls are inserted in the DOS. No need to continually set BASIC. Designed for use with 3P+S and any TV board.

Price is \$12.95 on diskette with manual. Delivery is stock to 14 days.

REGISTER is a cash register and inventory

control program. The software will control a point of sale terminal and printer. It will search inventory for an item, price and ticket it. Register has provisions for min-max, automatic re-order, and critical list.

Price is \$299.95 on diskette with manual. Delivery is 30 days.

All prices are FOB Santa Barbara, CA. Terms are COD + \$1.00 shipping. California residents add 6% sales tax. For information contact Alpha Data Systems, P.O. Box 267, Santa Barbara, CA 93102.

CIRCLE INQUIRY NO. 350

### Turnkey Minicomputer Client Writeup System

Version 5B of GIS-ABLE is a turnkey minicomputer financial control system for accountants and corporate financial officers.

The present version of ABLE features a complete hardware and software general ledger package designed for use on PDP-11 series minicomputers. The system is expandable to 64 CRT terminals. ABLE Version 5B operates in single job or timesharing modes.

ABLE is an interactive system capable of generating a full range of reports, journals and ledgers. Program flexibility permits completely individualized reports derived from any chart of accounts. Based on user needs, reports can be generated in dollars as well as non-monetary readouts such as gallons of gasoline, or product units, or telephone calls. Payroll recording and analysis also can be performed separately, or as an integral part of ledger posting.

For more information on ABLE, contact General Information Systems, Inc., 2024 N. Broadway, Santa Ana, CA 92706, (714) 834-0230.

CIRCLE INQUIRY NO. 336

### IAS Operating System for PDP-11s

Digital Equipment Corporation has an enhanced version of its Interactive Application System (IAS) operating software for large PDP-11 systems. IAS Version 2 is designed to support up to 32 interactive users, as well as additional peripheral equipment and software options.

IAS Version 2 is currently available for distribution to present users of PDP-11/45, PDP-11/60 and PDP-11/70 systems, or for delivery with new systems. The single-system license fee with full support is \$17,160. For more information contact Digital Equipment Corp., Maynard, MA 01754, (617) 493-2857, McLaren Harris.

CIRCLE INQUIRY NO. 343

### 16K Extended BASIC

This powerful BASIC was designed to maximize computational precision, programming power, and speed of execution by fully utilizing the extensive 150 instruction set of the Z-80 microprocessor. Major features include the capability of performing both 14-digit arithmetic, using BCD arithmetic instructions, and integer, 16-bit arithmetic; extended string handling capabilities; advanced floppy disk input/output capabilities; multi-statement lines; one, two and three dimensional arrays; 26 user-definable functions; advanced formatting capabilities with PRINT USING, TAB, SPACE and SYS functions; and direct machine language interaction with IN, OUT, PEEK, POKE and USR commands.

Cromemco 16K BASIC operates as part of CDOS, the Cromemco disk operating system. Both programs and data may be stored and retrieved, using either sequential or random access files, from easy to use 5" or 8" floppy disks. For Cromemco system customers, 16K BASIC is available on disk at a cost of \$95. 16K BASIC is also available on paper tape for \$75 or in PROM for \$800.

For additional information contact Cromemco, Inc., 2400 Charleston Rd., Mountain View, CA 94043, (415) 964-7400.

CIRCLE INQUIRY NO. 345



# BOOK REVIEWS

## THE DEVIL'S DUNGEON

By Dr. C. William Engel  
Engel Enterprises, 1978. 15 pages

Review by Col. E. Wingfield Verner

*The Devil's Dungeon* is a small book of 15 pages that contains a single game program which the author categorizes as an adult fantasy in BASIC. Fantasy it is, but whether it is adult or not is dependent upon one's definition of "adult."

The program appears to be just a massaged and expanded version of the many uninspiring cave and wumpus games that have been around for years. Instead of a wumpus we have monsters and demons and the ability to use a magic wand to sink to a lower level and another computer generated cave system. As far as I was able to determine by reading the instructions, one can never win this game. One can only flee with monsters and demons in pursuit ever lower into the bowels of the earth.

The printout for the game was found to be lacking in imagination or even humor and the game itself to be a completely unchallenging bore.

This program is just another example of how one can combine the crowning achievements of evolution and modern technology; the human brain and the electronic computer, and produce gibberish.

I could not in good conscience recommend this little book to anyone other than a dedicated and undiscerning game freak. □

## PASCAL USER MANUAL AND REPORT, SECOND EDITION

By Kathleen Jensen and Niklaus Wirth. Springer-Verlag, 1974  
167 pages, \$5.90, Paper

Review by Judy Scolney Robertson and Larry Robertson

The *PASCAL User Manual and Report* is the definition of standard PASCAL. The popularity of PASCAL as a programming language is growing so rapidly that everybody who thinks he can get away with it, is writing about PASCAL. This book is the definitive manual on the subject. The authors define PASCAL as a lan-

guage to be used for teaching good programming styles, for example structured programming, which is extremely difficult to do in BASIC. They accurately state that this ALGOL-like language goes beyond ALGOL by defining standard I/O, although this may not be totally adequate for future applications.

With PASCAL's growing popularity, there are many PASCAL compilers available — they currently exist for an extremely large number of CPUs. Most of these compilers are, in fact, written in PASCAL. PASCAL is a sufficiently powerful language that versions have been used in writing entire operating systems. The language is currently far more standard than BASIC, but many extensions have been proposed, and it is at present uncertain how standardized PASCAL will remain.

The manual is divided into two parts: the User's Manual, which includes a tutorial approach to how PASCAL is constructed and how to use it; and the Report, the formal definition of standard PASCAL. The Report is probably useful only to the compiler writer or standards person.

The manual itself is not for the beginning programmer. However, beginning books do not necessarily contain the entire language, as does this one. Written at a fairly high level, the *PASCAL User Manual and Report* is not the easiest reading. However, it is a vital reference for PASCAL users. □

## SEMICONDUCTOR CIRCUIT ELEMENTS

By T.D. Towers and S. Libes  
1977, Hayden Book Company  
309 pages, \$6.45, Paper

Review by Judy Scolney Robertson and Larry Robertson

*Semiconductor Circuit Elements*, originally written in 1975 in England, is a good introductory reference for semiconductor devices. The book has been updated, in America, and is the perfect guide book for the person familiar with circuitry. However, the book is not totally up to date with semiconductor technology.

The book covers MOS IC's, bipolar IC's, thick-film IC's, unijunction transistors, field-effect transistors, bipolar transistors, zener diodes, rectifiers, and LED's. A typical chapter is organized to discuss the

fundamentals of the device, including structure and operations, symbols, device characteristics, methods of fabrication, packaging and numbering, sample applications, review questions, and recommended further reading. Of particular interest is the historical data, notably where the terminology for digital circuits comes from.

A fairly detailed overview, *Semiconductor Circuit Elements* does not go into deep discussion of circuit characteristics. However, if you know a little about circuitry, you will find this book gives a good description of what is available and examples of what can be done.

Written on a level that the non-engineer can easily follow, *Semiconductor Circuit Elements* is a valuable reference source. □

## CALL FOR BUSINESS ORIENTED ARTICLES

INTERFACE AGE Magazine is seeking well-written articles related to the business world. These articles may cover any aspect of business as it relates to microcomputing.

Specifically, we would like articles describing hardware considerations for the small businessman. Software articles that present a useful application for any type of business activity.

Whether you are a doctor, lawyer, or candy butcher, if you use a microcomputer in your day to day business we want to hear about it.

Articles authored by individuals during leisure time are remunerated at a rate from \$15.00 to \$50.00 per published page and articles describing company projects carry author and company byline, but no honorarium is offered. Articles accepted will be acknowledged with a binder check within 30 days of receipt.

Manuscripts should be double-spaced, typewritten pages, one inch margins, and not less than 3½ pages in length (one published page). Pages should be numbered to insure correct text. Photographs should be numbered and labeled on the backside with a description. Photos should be taken with uniform lighting and background, in the form of glossy black and white prints. Tables, listings, etc., shall be on separate sheets. Computer listings shall be printed using a new ribbon to assure darkest print copy. Authors shall supply a statement of their background, expertise and level of accomplishment.

The publisher assumes no responsibility for artwork, photos, models, or manuscripts. Manuscripts are not acknowledged or returned unless accompanied by a self-addressed, stamped, return envelope.

For article submittal or more information, contact Carl Warren, Senior Editor, INTERFACE AGE Magazine, 16704 Marquardt Ave., Cerritos, CA 90701 or call (213) 926-9544.





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# SOFTWARE EDITORIAL

By A. A. Perez, Software Editor

## APPLICATIONS DESIGN — A Systematic Approach to Software Implementation

Install a light switch backwards, and the light won't light. A little bit of preplanning must take place to ensure that the correct actions are being followed. The design of software is the same. A little planning goes a long way in ensuring the reliability and usefulness of the final program. For example, in the decoding and checkout phase of an application, the amount of effort required to correct a design error is greater than if the error were detected at design time.

For commercially designed software, a systematic and orderly approach to the application implementation process is taken. This entails the coordination of both the hardware and software designers to ensure continuity in the effort.

When a system, both hardware and software, is being designed from the ground up, both the lead hardware and software designers work together. The purpose of this arrangement is to enhance the coordination of the selection of the hardware components and the software features. This particular method prevents "finger pointing," between the designers, when undesirable features are identified after the design phase.

However, for the typical consumer computer owner, the hardware is already designed and exhibits the features created by the original designers. Therefore, the inherent characteristics of the basic system must be understood before an application is implemented. The basic computer hardware and support software are fixed. The owner has the basic system, but rarely the expertise required to modify it. For the owner that wishes to modify the system, he is on his own. The product warranty and specifications are no longer valid.

Figure 1 is a block diagram of the life cycle of a software product. Basically, there are 5 phases of a programming project, after the need for the program is established, and the requirements defined:

- Program Design — Phase I
- Coding and Check Out — Phase II
- Testing — Phase III
- Implementation/Integration — Phase IV
- Operation and Maintenance — Phase V

Each phase of the project is important, and must be handled as a separate item.

The first action that must be taken is defining the project, and determining its scope and depth. From this point it is then possible to proceed to the design phase of the project.

The design phase of the project is the creation of a *development specification*. This specification is the

result of the analysis of the established requirements of the project, the restrictions of the hardware and development software. Also within this specification the total system parameters must be spelled out, to prevent some important element being forgotten. For software systems being created for more than one user, the training requirements must also be addressed.

During the later stages of the design phase, coding of the bottom segments of the flow chart (if a structured design was followed), can be done by the less experienced members of the design team. But if the whole project is being handled by one person, then that person will have to resist doing any coding until he has completed the top of the structured program. This indicates that if only one person is doing the program project, he has to follow the top to bottom concept of structured programming.

Once the program is coded, it is then integrated into the system. But the coding and checkout must be performed segment by segment, because it is easier to check out a segment at a time rather than check out the entire program code. Also, the integration phases will be easier with segments which are known to be "debugged" and tested individually.

After system integration, the final phase of system operation and maintenance becomes of primary importance. Both the hardware and software must be maintained, and will be a topic of a later editorial. In using the concepts of structured programming, and application can be developed quickly and efficiently. Using these techniques, coding and checkout can be accomplished by several programmers, on more than one module of the program. This concept facilitates identification of design errors and modifications of the development specification. Similarly, problems identified during the testing and integration phases are used to modify any of the preceding phases.

The final result of structured applications design is the product which is achieved at the integration phase. At this point a final system document is created called the *product specification*. This is the guide that will be used by the end user. The *product specification* differs from the *development specification* by deleting features that caused implementation problems, or adding features that facilitated implementation.

Although this discussion is merely an overview of application design, it should give you a guide to the various steps in the process of application implementation. In subsequent issues of this magazine, expect more detailed discussion of the various phases of the software life cycle. □

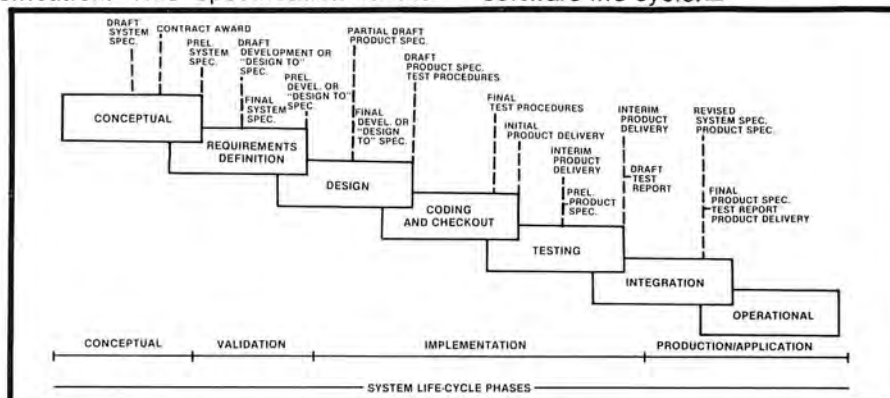
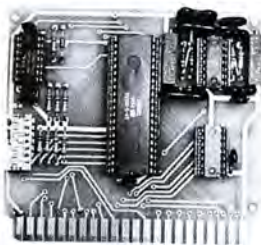


Figure 1. Software Life-Cycle Phases.



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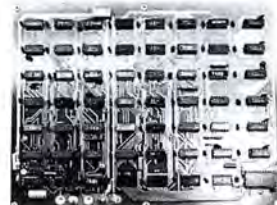
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E21



# Interpreters VS. Compilers

By Rick Gros

*Within the industry many buzz words are bantered around without taking the time to determine if anyone really understands what is being talked about. Consequently, a fair amount of misinterpretation takes place, particularly when discussing interpretive languages versus compilers. Rick provides easily understood explanations of the differences between the programming systems.*

*This article is a must for the novice, and an excellent source for the professional programmer.*

—Editor

## DIFFERENCES BETWEEN COMPILERS AND OTHER SYSTEMS

What is a compiler? The immediate differences between compilers and other systems will begin to become evident when compared in terms of: Is it interactive; how big is the code; how fast is the code; what happens to the original source; how can the original source be changed; what about runtime packages, and total development time for an application. Therefore, these are the points that will be considered in the following discussion.

The differences between compilers, incremental compilers, and interpreters can best be illustrated with the following analogies. Assume we have an English and Spanish speaking butler, and a Spanish speaking maid. The butler can be thought of as the programming system being considered, and the maid can be thought of as the computer hardware.

With a compiler system, you give instructions to the butler, who then translates them into Spanish, and leaves the list for the maid (who is probably busy now, but will do it later). Sometimes you can't find the butler, so you leave a cassette tape recording of your instructions for him to translate later.

Incremental compiler systems require that you give the butler one instruction at a time which he translates into Spanish and places onto little slips of paper arranged on a bulletin board. This is done so that the maid can concentrate on one little job at a time. When the maid finishes a task described on one little piece of paper, she asks the butler which one to take and do next. Sometimes she must do the same task again, so she leaves the notes on the bulletin board in case they're needed later. At any time, you can ask the butler how the maid is doing, and can change portions of the instructions if you wish. If you do this, the butler takes down all the notes for cancelled instructions, and puts up new ones for any new instructions.

With an interpreter system, you give the butler instructions which he writes down in English and arranges on a bulletin board. When you ask the butler to carry out the instructions, he will translate one instruction into Spanish so that the maid can do it. When the

maid is done, she comes back to the butler and he will then translate the next instruction into Spanish so she can do that one. If the interpreter is "interactive," you can ask the butler how the maid is doing, and can change portions of the instructions if you wish. If you do this, the butler takes down any notes for the cancelled instructions, and puts up new ones (still in English) for any new instructions.

An interactive system is one where you can converse with the butler whenever you like. Non-interactive systems require you to write him a letter, or leave him a cassette tape. The butler acts as a translator (such as a compiler or interpreter), and the bulletin board is the butler's way of organizing the statements.

Interactive interpreters (such as most BASICs and APL) usually keep track of program variables and line numbers, (note there are non-interactive interpreters such as SNOBOL). The person using such a system can ask the interpreter to display the contents of program variables, list his program, run his program, and edit his program in any order he desires. The important point to note is that the program variables can be displayed easily, aiding debugging. This is useful because while debugging a program, these program variables can be displayed by manual intervention at interesting points in the program. However, programs execute rather slowly (the butler is always re-translating his slips of paper).

In compiler systems, the ability to interrogate program variables in a debug session is usually not provided (such as FORTRAN and ALGOL). Of course, there are other ways to do this: 1) use print statements at the interesting points in the program being debugged to display critical variables, or 2) use a debug program to examine the memory locations allocated for the variables by looking on a load map to find their location — this one only works if static allocation is used. In systems like ALGOL, the variable allocation is dynamic, and finding a particular variable may be difficult and frustrating. The advantage of a compiler is speed; all the butler's notes are in Spanish so the maid can read them all quickly.

An incremental compiler is a compromise between the interpreter and the compiler. It has the same interactive properties of an interpreter, and the advantages of a compiler in that the code executes fast (the butler's notes are still all in Spanish). The way this compiler works is: a statement is entered by the programmer; the statement is immediately compiled and stored in memory; and the process repeats. Statements are compiled one at a time, in the order they are given. Generally, less syntactic (structural) analysis and error reporting can be performed because each statement is compiled without regard to the context in which it may appear. For instance, let's say we have an incremental BASIC compiler. The user might enter:



```

10 FOR I= 1 TO 20
15 FOR J= 1 TO 20
20 NEXT I
30 NEXT J

```

Obviously, the nesting of the FOR/NEXT loops is improper. But, this kind of system might not discover the error until runtime (while the program is actually executing).

Other elements of an incremental compiler system include (as in the interpreter) commands for loading and saving programs, a lister, editor, and a method to conveniently display variables. A big disadvantage is that incremental compilers generally require a fair amount of memory.

Now come the more specific details. Here I will discuss the points previously listed.

### IS IT INTERACTIVE?

The interpreter and incremental compiler are and the compiler isn't (generally speaking; some compilers do provide debugging and tracing facilities that are interactive).

### HOW BIG IS THE CODE?

This will be explained in terms of how much space is actually required for the application, and how much additional overhead is required by the programming system to make the whole package work.

Interpreter systems can store the user's program in textual form, and interpret each statement as it needs to be executed. In this case the "code" for the user's program is as large as the source in bytes. Another method is to compress the keywords into tokens which are easily recognized as each statement is interpreted at runtime. There are other variations, but generally speaking, the code is approximately the size of the source. At the keyboard, the user will want to enter commands such as LOAD, SAVE, LIST, and RUN, and be able to edit his program. For this, there is a fixed space overhead required to perform these types of operations (which includes code required to do the interpreting, and some kind of runtime package that assists in performing useful runtime functions for the interpreter such as floating point arithmetic, transcendentals or interfacing file operations to the operating system, to name a few).

Compiler systems use several different methods for storing the code. One scheme is to translate a source program into machine code, and either 1) provide a runtime package to handle floating point arithmetic, transcendentals . . . , or 2) provide references to the needed runtime routines and use a link editor to access and provide only what functions are needed from a common function library. With the first scheme, compiled programs have a fixed space overhead, regardless of whether floating point or transcendentals . . . are required. With the second, a compiled program has only the space overhead for the required functions.

A third scheme is to translate a source program into what is called "pseudo operation code" or "pop code". This type of code looks like a set of machine instructions for some imaginary or "ideal" computer. These instructions, therefore, must be simulated on the target computer. Note that a certain amount of code transportability is afforded by this technique. To move programs compiled into a pseudo code, one must only provide the simulator on the target machine.

Let's take a look at some types of compiled code. For example, let's say that we have a BASIC compiler that compiles code for 16-bit two's complement integer arithmetic operations on a 6800 microprocessor. The examples below will show the code compiled for " $Z = Q + Y$ " and " $Z = Q * 5 + Y / 3$ ". The first code method will be straight-line code, method A1 and A2 (Figure 1), just like an assembly language programmer would produce. The second method is a variation that does a series of operations like a stack oriented calculator, method B1 and B2 (Figure 2). The third method is like the second, except that pseudo code is used instead of machine code, method C1 and C2 (Figure 3).

COMPILED INTO MACHINE CODE					
METHOD A1: $Z = Q + Y$			METHOD A2: $Z = Q * 5 + Y / 3$		
	BYTES	CYCLES		BYTES	CYCLES
LDX	Q	4	LDX	Q	4
LDX	Q+1	4	CLRA		2
ADDB	Y+1	4	LDAB	#5	3
ADCA	Y	4	JSP	MULT	538
STAB	Z	3	STAB	TEMP1	2
STAB	Z+1	3	STAB	TEMP1+1	2
			LDX	#3	3
TOTAL	18	20	LDAB	Y	4
			LDAB	Y+1	4
			JSR	DIV	577
			ADDB	TEMP+1	3
			ADCA	TEMP+1	3
			STAB	Z	4
			STAB	Z+1	4
			TOTAL	35	1147

Figure 1.

COMPILED INTO STACK ORIENTED MACHINE CODE					
METHOD B1: $Z = Q + Y$			METHOD B2: $Z = Q * 5 + Y / 3$		
	BYTES	CYCLES		BYTES	CYCLES
JSR	LOADA	3	JSR	LOADA	3
FDB	Z	2	FDB	Z	2
JSR	LOADV	3	JSR	LOADV	3
FDB	Q	2	FDB	Q	2
JSR	LOADV	3	JSR	LOADI	3
FDB	Y	2	FDB	5	2
JSR	ADD	3	JSR	MULT	3
JSR	STORE	3	JSR	LOADV	3
			FDB	Y	2
TOTAL	21	309	JSR	LOADI	3
			FDB	3	2
			JSR	DIV	3
			JSR	ADD	3
			JSR	STORE	3
			TOTAL	37	1683

Figure 2.



COMPILED INTO "POP" CODE

METHOD C1: Z = Q + Y			METHOD C2: Z = Q*5 + Y/3		
	BYTES	CYCLES		BYTES	CYCLES
OPLGADA	1	15+38	OPLGADA	1	15+38
FDB Z	2		FDB Z	2	
OPLGADV	1	15+46	OPLGADV	1	15+48
FDB Q	2		FDB Q	2	
OPLGADV	1	15+46	OP5	1	15+25
FDB Y	2		OPMUL	1	15+559
OPADD	1	15+58	OPLGADV	1	15+48
OPSTORE	1	15+58	FDB Y	2	
			OP3	1	15+25
	11	75+234	OPDIV	1	15+611
			OPADD	1	15+58
			OPSTORE	1	15+58
TOTAL	11	389			
			TOTAL	15	1569

Figure 3.

Methods A and B are very close in space requirements. Method C appears to be the best from a space point of view.

C1 IS ABOUT 61% THE SIZE OF A1  
 C1 IS ABOUT 52% THE SIZE OF B1  
 C2 IS ABOUT 43% THE SIZE OF A2  
 C2 IS ABOUT 41% THE SIZE OF B2

But what about a runtime package? In A, routines are still required for multiplication and division. The same is required for B and C with the addition of a few small routines to load stack, do arithmetic on the stack and store from the stack. These extra routines, when compared to the common collection of routines needed by A, B and C is small in comparison to the entire set, especially if the language is complex. Furthermore, if floating point arithmetic is considered, the stack method (B and C) become more attractive because of the extra difficulty (and extra code) required to pass values to the arithmetic routines in simple assembly language. Should such a scheme be chosen, A would greatly suffer in complexity and code, while B and C would not change one byte. One more comment on B and C: this code is exactly like the sequence of operation that some of the pocket calculators use. It's called reverse Polish notation (operands precede operators) and code for these types of operations is easy to generate.

Assuming that you need floating point and other complex operations, the runtime package should contain the same types of routines that an assembly-language programmer would use with his program, such as conversion operations, I/O, floating point, transcendental, etc. That is, if the assembly-language programmer would duplicate all the functions normally provided by a runtime package, he should come close to the runtime package in size.

Further, let's compare method C to assembly language programs. Assume a 10000 byte runtime package for method C, and no runtime package of any form for the assembly language program. Also, that the packing of the assembly program is equivalent to method A2 above. This means that the packing of C is .43 times the packing of assembly code. If we solve the equation:  $X = 10000 + .43X$ , then we find the break-even point. This is the point at which a given program written in assembly or compiled by method C requires exactly the same amount of total space. The solution is:  $X = 17543$ . It is after this point that programs compiled in method C

begin to take up significantly less space than the equivalent program written in assembly code. Further, if we solve the equation:  $65536 = 10000 + .43X$ , we find how big of an equivalent assembly program could be compiled by C and still fit in 64K. The solution is:  $X = 129153$ . This means that a program that is equivalent to a 129000 byte assembly program, when compiled using method C fits in a 64K machine.

Let's assume that the assembly language program needed more complex functions, such as floating point, transcendental, string operations, I/O, file operations, and error handling. All of this might fit in a 6000 byte runtime package. Let's leave the 10000 byte runtime package for method C, which contains the same as the 6000 byte RTP plus extra code for pop code decoding, stack operations, faster floating point (this takes up more code) or BCD arithmetic. Now, let's compute the break-even point for this example:  $6000 + X = 10000 + .43X$ . The solution is:  $X = 7107$ . X is the amount of space required for the code part. Add to this the 6000 byte RTP and we get 13017, which is about 12.7K. This is obviously a good deal in a 16K system. These results are shown on the graph in Figure 4.

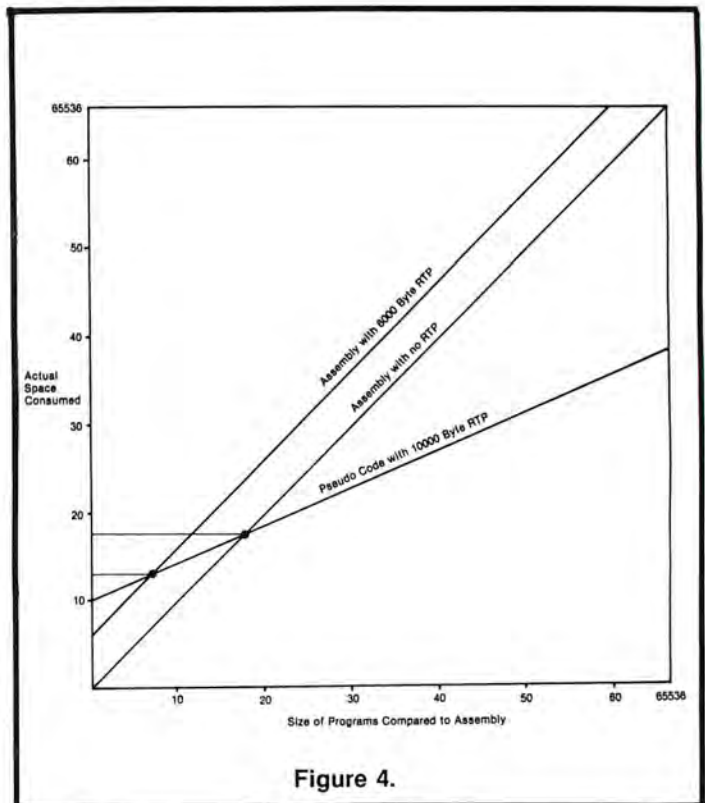


Figure 4.

Incremental compilers have the same options as compilers do as far as code generation. The differences on how it is actually done show up in that a block of memory is usually allocated to contain the code for a statement and is de-allocated if the statement is removed. If pseudo code is generated in a clever enough way, the source won't have to be retained. This assumes that variable names are retained in a symbol table and clever reverse compiling techniques will produce the original text for listing and editing. Otherwise, the text will also have to be retained for listing and editing. A similar runtime package would be required as in the interpreter. This means incremental compilers typically use at least as much space as an interactive interpreter, and usually more.



## HOW FAST IS THE CODE?

For interpreters, there tends to be significant overhead in recognizing keywords, evaluating the semantics (meaning of a statement), and looking up variables and line numbers in symbol tables. As the program grows in size, so do the symbol tables, and so does the lookup time (you can imagine how slow a BASIC interpreter would be if it had to search a list of 100 to 200 line numbers for each GOTO statement it executes). In some systems, some of the keywords and variables may be stored as tokens, so some of the overhead can be saved.

For compilers, we need more discussion. In the section on space, three methods of code output were discussed. The speed of the code can be related to which code method is considered. Let's use the timing figures provided for the coding examples A, B and C from the previous discussion. Looking at A1, we find that straight-line code has only machine execution overhead. B1 has the additional overhead of the JSR's and the routines to perform the stack operations. Here the return address went on the value stack and had to be pulled off before the specified stack operations could be done. All of this made B1 about 12 times slower than A1. C1 has the additional overhead of the "decoding" loop of 15 machine cycles, but the stack was ready to do the stack operation at the entry point of the simulation routines. All of this made C1 exactly as fast as B1, which is about 12 times slower than A1.

Now comes the interesting part. By making the types of operations more complicated (multiplications and division, instead of addition) the straight-line example A2 required 1147 cycles to get results. B2 took 1603 cycles. B2's additional overhead, again can be found in having to do the extra JSR's and pulling the return address off the value stack before doing the indicated stack operation. Here we have B2 only 1.40 times slower than A2. C2 took 1589 cycles, slightly faster than B2. C2's overhead again is the decoding loop and the simulation routines. All together, C2 was 1.39 times slower than A2. Earlier we found that C1 was 12 times slower than A1, but here we find that C2 is only 1.39 times slower than A2. The reason for this is that we introduced single operations that were very much more complex and time consuming, considerably increasing the amount of real work being accomplished relative to the amount of time spent decoding the pseudo opcodes and simulating their actions. Furthermore, as the operations become extremely complex (such as copying character strings or doing floating point operations) the decode time becomes relatively insignificant. For languages such as APL, even though it's interpreted, the interpretive overhead is so small compared to the amount of time spent doing real work, that the fact that it's interpretive begins to become insignificant.

A speed study of incremental compilers would show slightly slower execution times as compared to the compiler study for the same generated code method.

## WHAT HAPPENS TO THE ORIGINAL SOURCE?

In interpretive and incremental compiler systems, the source is kept around in some form so that editing and listing operations can be done.

In a compiler system, there is no source available at runtime for listing and editing. Source programs must be prepared with an editor or whatever text processing system is available, then translated by the compiler into some form of object code.

## WHAT ABOUT EDITING?

In interpretive systems and incremental compiler systems, interactive editing is usually available. In compiler systems, editing is separate from the compiler and is not available at runtime.

## ARE RUNTIME PACKAGES REQUIRED FOR ALL SYSTEMS?

Complicated or common functions such as floating point, etc., that can't be done directly in hardware (except on larger, more expensive machines) are typically found in a runtime package for interpreters and incremental compilers. Compiler systems can use a runtime package, or use a link editor to link a program with only that portion of the runtime package (usually from a library) that is required. But the real answer is yes, runtime support is almost invariably required in some form.

## WHAT ABOUT TOTAL DEVELOPMENT TIME OF A PROGRAMMING TASK?

Most programmers believe that interactive systems (interpreters and incremental compilers) are the best for developing application software. This is probably unquestionably true for the learning beginner and the novice programmer. But what about the expert, building large programs? Here the answer is not quite so clear. Studies have been made that show overall man hours spent on a given programming task were approximately equal for interactive and batch environments. If this is true, then a possible conjecture may be that a programmer may tend to become lazy and less thorough in his designs when using an interactive approach. He may be able to debug his program faster, but how many bugs did he design into his program simply because he was less careful in his design? On the other hand, for the programmer who is careful in his design, an interactive environment is a nice thing to have.

However, let's take a look at a particular example. Let's say that we have an experienced BASIC programmer assigned a task that takes 100 hours to complete. Further, let's estimate the total design and coding time to be about 60 hours, overall editing time to be about 10 hours, overall debugging and testing time to be about 25 hours, and total compilation time to be about 5 hours. Further, let's be optimistic and say that interpreters spend about 5 times less time preparing code for execution than do compilers, so that the 5 hours of compilation would drop to 1 hour if using an interpreter. Now we have the job completed in 96 hours rather than 100 hours. The difference compared to the total development time becomes so insignificant that I can't arbitrarily elect one system as superior to another.

The evaluation of a system should be based upon how suitable it is for the job that needs to be done. The emphasis usually placed on the issue of Compiler Vs. Interpreter should not overwhelm other considerations such as space, speed, features of a language, ability to link to assembly if needed, whether or not the code is ROMable if needed, whether or not the software is reliable, and what kind of support is offered.

SD BASIC, developed by Software Dynamics, is a compiler rather than an interpreter, for the reasons presented within this article. Although in the design of the compiler, we sacrificed interactivity, it has been more than made up for in the total advantages gained.

*Rick Gros can be contacted at Software Dynamics, 17914 S. Laurel Brook Place, Cerritos, CA 90701, (213) 926-6492. —Editor* □



# Software Aid for Firmware Production

By Owen F. Thomas

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**Software** — A computer program for execution from read/write random access memory.

**Firmware** — A computer program for execution from read only memory (ROM) or programmed read only memory (PROM).

---

You can have a custom PROM for your computer without the expense of a special programmer. Electronic distributors will program a PROM for no additional charge when you buy it. The trick is to tell the distributor exactly what you want in the memory. He may be able to provide special cards for you to mark with the desired program, bit by tedious and error prone bit. Or, the errors and tedium can be avoided when you have a paper tape punch and a program to dump memory to tape in an acceptable format after you are certain that the program does what you want.

Here are two programs which were used in producing PROMs for SPECTRUM 128 as described in the May 1977 INTERFACE AGE (Help Your Computer Understand Your Voice). The PROMs were mounted on an adapter board in a microcomputer development system from E.P.A. in San Diego, California. Fairchild 93448 parts were produced using tape punched by the program named LBPNT (see Program A). Monolithic Memory 6341 parts were produced using a tape punched by the program named SBLHFE (see Program B).

These programs are quite similar, as will be seen from the listings. The start of a word is indicated by an ASCII B and the end of a word is indicated by an ASCII F in both programs. Program SBLHFE uses an ASCII L to indicate a zero (low logic level) bit, and uses an ASCII H to indicate a one (high logic level) bit. Program LBPNT uses an ASCII N to indicate a zero (low logic level) bit, and uses an ASCII P to indicate a one (high logic level) bit. Verify with your intended distributor that he agrees with one of these conventions before you ask him to program a part. After each ASCII F there are control characters for carriage return and line feed. These characters should be ignored by the PROM programmer, they are used to allow teletype listing of the tape.

Before the first word starts there is a leader and after the last word there is a trailer. Program LBPNT uses a block of 25 ASCII null characters each for leader and trailer. Program SBLHFE uses an ASCII S for the leader and an ASCII E for the trailer. Now you can probably guess why the programs have their names! I believe that Intel was first to specify a paper tape format for PROM programming, and that LBPNT produces a tape to their specification. Teletype listings from program SBLHFE are much easier for me to read and verify. You and your supplier can choose which one to use.

Paper tape for a 512 word program will be almost 50

feet in length when punched by one of these programs. The distributor may offer to make you another tape in binary format, and produce a tape with the same information in less than 5 feet. The binary tape uses one row of eight holes to represent one word of eight bits. The tapes produced by these programs use ten rows of holes in ASCII code to represent each word. There is a good reason for a tape which is ten times as long as a binary tape. The long format is used to allow teletype listing of the tapes and to allow tapes to be transmitted over a TWX link to a programming site in a different city. A binary tape will probably contain hole patterns interpreted as ASCII control symbols which will not print, and will make the teletype do strange things. Even if the teletype does list a binary tape, it will be difficult to read the symbols and verify that the tape is correct.

Your system will need the MIKBUG™ ROM routine at E1D1 to output the characters to the punch. You will need a few words of RAM for the selected PROM tape output program and one scratchpad word at address A04A in the same RAM that is used by the MIKBUG™ routine up through address A049. The programs are shown assembled at starting location 0000, but they are completely independent of the location. You can relocate them anywhere you like. The program start is at 0000, or at the first address of the block where you decide to put it. The program you are dumping to tape should have its starting address placed in A002 and A003; place its ending address in A004 and A005. Start the punch program, and after a short delay it will start to punch tape. The delay is to allow you time to turn on your punch if it is not automatic.

Try to avoid mistakes, they are costly when not using erasable memories. Remember to try your program in RAM for correct operation before punching tape, but also remember that all RAM actually modified by your program must be outside the addresses becoming converted to PROM firmware. Be careful of all extended addresses to locations within your program; you may have to change them to be correct when you place the PROM at a different address. Make your paper tape with exactly as many words as there will be in the PROM. PROM programmers sometimes require that the word count be correct. Then when you have finished, tell the rest of us of your successes, and warn us against any traps you have discovered. □



## Program A

```

00010      NAM      LBNFT
00020      * OWEN F. THOMAS JUNE 2, 1977
00025      * PUNCHES TAPE FOR FAIRCHILD FROM BURNER
00030      * ENTER WITH START ADDRESS IN A002,A003;
00040      * STOP ADDRESS IN A004,A005.
00047 0000      ORG      $0000
00048 0000 86 7F  START  LDA A  #57F
00049 0002 36      PSHA  PSH A
00050 0003 36      PSH2  PSH A
00051 0004 4A      DELAY  DEC A          DELAY FOR MANUAL PUNCH
00052 0005 26 FD      BNE          TURN-ON
00053 0007 32      PUL A
00054 0008 4A      DEC A
00055 0009 26 F8      BNE          PSH2
00056 000B 32      PUL A
00057 000C 4A      DEC A
00058 000D 26 F3      BNE          PSHA
00059 000F 86 12      LDA A  #512          ASCII CHAR. FOR AUTO
00060 0011 BD E1D1     JSH          #E1D1      PUNCH TURN-ON
00061 0014 C6 19      LDA B  #25
00062 0016 86 FF      LDA A  #5FF          ASCII NULL CHAR. TO
00063 0018 BD E1D1     LDKPCH JSH          #E1D1      PUNCH LEADER
00064 001B 5A      DEC B
00065 001C 26 FA      BNE          LDKPCH
00066 001E FE A002     LDH          $A002
00067 0021 09      DEX
00068 0022 20 26      BHA          TESTN2      INDEX IS INCREMENTED BEFORE
00069 0024 86 42      LDA A  #542          EACH WORD
00070 0026 BD E1D1     JSH          #E1D1      ASCII "B"
00071 0029 08      INX          PUNCH
00072 002A 86 08      LDA A  #508          INCREMENT INDEX OF WORD
00073 002C B7 A04A     STA          COUNT
00074 002F 0C      CLC
00075 0030 E6 00      LDA B  0,X
00076 0032 58      SHIFT ASL B
00077 0033 25 0C      BCS          OUTH
00078 0035 86 4E      LDA A  #54E          ASCII "N"
00079 0037 BD E1D1     JSH          #E1D1      PUNCH
00080 003A 7A A04A     DEC          COUNT
00081 003D 26 F3      BNE          SHIFT
00082 003F 20 04      BHA          TESTND
00083 0041 86 50      OUTH  LDA A  #550          ASCII "P"
00084 0043 20 F2      BHA          PUNCH
00085 0045 86 46      TESTND LDA A  #546          ASCII "F"
00086 0047 BD E1D1     JSH          #E1D1      PUNCH
00087 004A 86 0D      TESTN2 LDA A  #50D          ASCII CARRIAGE RETURN
00088 004C BD E1D1     JSH          #E1D1      PUNCH
00089 004F 86 0A      LDA A  #50A          ASCII LINE FEED
00090 0051 BD E1D1     JSH          #E1D1      PUNCH
00091 0054 BC A004     CPX          $A004      LAST ADDRESS ?
00092 0057 26 CB      BNE          WOKDO      NO, OUTPUT ANOTHER WORD
00093 0059 C6 19      LDA B  #25
00094 005B 86 FF      LDA A  #5FF          ASCII NULL CHAR. TO
00095 005D BD E1D1     FINPCH JSH          #E1D1      PUNCH TRAILER
00096 0060 5A      DEC B
00097 0061 26 FA      BNE          FINPCH
00098 0063 86 14      LDA A  #514          ASCII CHAR. FOR AUTO
00099 0065 BD E1D1     JSH          #E1D1      PUNCH TURN OFF
00100 0068 7E E0E3     JMP          $E0E3      RETURN TO MIKBUG CONTROL
00101 006A A04A      COUNT EQU          $A04A
00102 006D      END

```

TOTAL EHH0K5 00000

## Program B

```

00010      NAM      SBLHFE
00020      * OWEN F. THOMAS JUNE 4, 1977
00025      * PUNCHES TAPE FOR MONOLITHIC MEMORIES FROM BURNER
00030      * ENTER WITH START ADDRESS IN A002,A003;
00040      * STOP ADDRESS IN A004,A005.
00047 0000      ORG      $0000
00048 0000 86 7F  START  LDA A  #57F
00049 0002 36      PSHA  PSH A
00050 0003 36      PSH2  PSH A
00051 0004 4A      DELAY  DEC A          DELAY FOR MANUAL PUNCH
00052 0005 26 FD      BNE          TURN-ON
00053 0007 32      PUL A
00054 0008 4A      DEC A
00055 0009 26 F8      BNE          PSH2
00056 000B 32      PUL A
00057 000C 4A      DEC A
00058 000D 26 F3      BNE          PSHA
00059 000F 86 12      LDA A  #512          ASCII CHAR. FOR AUTO
00060 0011 BD E1D1     JSH          #E1D1      PUNCH TURN-ON
00061 0014 86 53      LDA A  #553          ASCII S TO MARK TAPE START
00062 0016 BD E1D1     JSH          #E1D1      PUNCH FOR LEADER
00063 0019 FE A002     LDH          $A002
00064 001C 09      DEX
00065 001D 20 26      BHA          TESTN2      INDEX IS INCREMENTED BEFORE
00066 001F 86 42      LDA A  #542          EACH WORD
00067 0021 BD E1D1     JSH          #E1D1      ASCII "B"
00068 0024 08      INX          PUNCH
00069 0025 86 08      LDA A  #508          INCREMENT INDEX OF WORD
00070 0027 B7 A04A     STA          COUNT
00071 0029 0C      CLC
00072 002B E6 00      LDA B  0,X
00073 002D 58      SHIFT ASL B
00074 002E 25 0C      BCS          OUTH
00075 0030 86 4C      LDA A  #54C          ASCII "L"
00076 0032 BD E1D1     JSH          #E1D1      PUNCH
00077 0035 7A A04A     DEC          COUNT
00078 0038 26 F3      BNE          SHIFT
00079 003A 20 04      BHA          TESTND
00080 003C 86 48      OUTH  LDA A  #548          ASCII "H"
00081 003E 20 F2      BHA          PUNCH
00082 0040 86 46      TESTND LDA A  #546          ASCII "F"
00083 0042 BD E1D1     JSH          #E1D1      PUNCH
00084 0045 86 0D      TESTN2 LDA A  #50D          ASCII CARRIAGE RETURN
00085 0047 BD E1D1     JSH          #E1D1      PUNCH
00086 004A 86 0A      LDA A  #50A          ASCII LINE FEED
00087 004C BD E1D1     JSH          #E1D1      PUNCH
00088 004F BC A004     CPX          $A004      LAST ADDRESS ?
00089 0052 26 CB      BNE          WOKDO      NO, OUTPUT ANOTHER WORD
00090 0054 86 45      LDA A  #545          YES, LOAD ASCII E TO
00091 0056 BD E1D1     FINPCH JSH          #E1D1      PUNCH FOR TRAILER
00092 0059 86 14      LDA A  #514          ASCII CHAR. FOR AUTO
00093 005B BD E1D1     JSH          #E1D1      PUNCH TURN OFF
00094 005E 7E E0E3     JMP          $E0E3      RETURN TO MIKBUG CONTROL
00095 006A A04A      COUNT EQU          $A04A
00096 006D      END

```

TOTAL EHH0K5 00000

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# HEXMON: An 8080 Intel HEX-Format Paper-Tape Monitor

By Alan R. Miller

New Mexico Tech, Socorro, NM 87801

## HEX-CHECKSUM FORMAT

HEXMON is a program that can be used for dumping, loading and verifying object programs on paper tapes in the Intel HEX-checksum format. Object tapes obtained from such companies as Processor Technology and Technical Design Labs are also punched in this format. Information stored in memory is punched as a series of records, each with the following format:

### Character 1: RECORD HEADER

An ASCII colon (3A HEX) signals the start of each record.

### Characters 2, 3: RECORD LENGTH

Two ASCII HEX characters give the record length (the number of 8-bit data bytes in record). End of file is indicated by a record length of zero.

### Characters 4-7: LOAD ADDRESS

Four ASCII HEX characters give the address (most significant byte first) where the first data byte of the record is located.

### Characters 8, 9: RECORD TYPE

The record type is 00 except for the last record of autostart files, for which it is 01.

### Next Characters: DATA

Two ASCII HEX characters represent each 8-bit data byte.

### Last 2 Characters: CHECKSUM

Two ASCII HEX characters give the negative of the sum of all previous bytes in the record, except for the colon. The sum of these bytes plus the checksum equals zero.

A carriage return, line feed, and nulls occur before another colon signifying the start of the next record. Paper tapes punched in this format take twice as long to load as compared to binary tapes since it requires two 7-bit ASCII HEX characters to represent each 8-bit byte of memory. For shorter programs, this problem is lessened by the advantage of having a tape that will print in human-readable form when run through a teletype.

HEXMON has three main sections: DUMP, LOAD/VERIFY, and GO. The first section can be used to punch an object program on paper tape. The second part can be used to load a program into memory or verify that a tape was properly punched. The third part is used to go somewhere else when you are finished with this program.

## RUNNING THE PROGRAM

HEXMON is started at the beginning by jumping to the label START. To load a tape, type an "L" and a car-

riage return. The tape reader will start up (if it is automatic) and the object program will be loaded into memory. When finished, the tape reader will be shut off, the autostart address will be printed and HEXMON will be restarted. This mode would be used if a program is to be altered before startup. If the program is to be executed after loading, type an "A" (for autostart) and a carriage return. Now after the tape is loaded, the program counter will jump to the autostart address.

A program can be loaded at an address other than its normal address by typing an "O" (for offset), an offset address of four HEX characters, and a carriage return. The offset address is added to the record address after the latter has been added to the checksum. An offset of 2000 will load the program 8K bytes above its normal address. An offset of F000 or -1000 will load the program 4K bytes lower.

Tapes without checksums, or tapes that have one or two defects can be loaded by typing an "N" and a carriage return. A checksummed paper tape can be produced by typing a "D" (for dump), the starting address of four HEX characters (most significant byte first), the stop address (four HEX characters), the autostart address (four HEX characters), and a carriage return. The autostart address will normally be the starting address of the program. Alternately, the address of your regular monitor could be used. (There is no reason to use the address of HEXMON, since a load command of "L" will branch back here at the completion of the load.) If an error is made while entering the information, type a Control-X and HEXMON will restart giving a "#".

Since each record of a file has its own load address, several non-contiguous patches can be punched on one tape (file) with the H,P,E series of commands. For example, update patches to a long program can be punched as a series of separate records with one end-of-file record for the whole tape. Here the autostart address would logically be the starting address of the main program. Load the original program with the "L" option so it will not start up. Then load the patch tape with the "A" option so that the main program will start up after the patches have been loaded on top of the original program.

To make the patch tape, first type an "H" (for header) to produce a blank leader. Then type a "P" (for patch), the start address (four HEX characters), the stop address (four more HEX characters), and a carriage return (no autostart address as in a regular dump). The selected portion of memory will be punched out and the program will await an additional command (no end-of-file record or trailer at this time). Additional patches can now be



punched by using the "P" command again. When all the patches have been made, type "E" (for end), an autostart address, and a carriage return. The end-of-file record (with a record length of zero and a record type of 01) will be punched, including the autostart address. A blank trailer will also be punched and HEXMON will be restarted.

Typing a "G" (for go), a 4-character address, and a carriage return will allow you to go to another program.

## SUMMARY

HEXMON requires 664 bytes of memory including seven levels (14 bytes) of stack. The program will run in less memory if the stack is replaced elsewhere. We put the stack for our programs near the top of memory in a 1K memory board (an original MITS) addressed to F000 HEX. (You can buy a 4K memory board with all components but memory for less than \$50, then buy 1K of 21L02 memory chips to go in it. Cut the address-select lines for the other three K rows and tie them to the five-volt supply.)

HEXMON is written for a console addressed to 10/11 HEX (20,21 octal) and a punch/reader addressed to 12/13 HEX (22/23 octal). All of the input/output routines are located together near the beginning of the program so they can be easily changed. In particular, a single terminal such as a teletype, can be used for both the console and the tape punch/reader. But in this case, the tape-input routine (which doesn't echo) and the keyboard-input routine (which does echo) must both be retained. Otherwise, data read from a tape will be echoed on the console and won't be input properly. The keyboard-input routine ignores any nulls that might be input from the trailer of a paper tape, while it is searching for the next command. The following table gives the addresses and values that might have to be changed for your system. For example, if your interface chip is active low, change the JUMP ZERO to JUMP NOT ZERO. Column 2 gives the corresponding labels for the source program, which was written with a MITS Software Package II assembler. The commonly used record length of 10 HEX (16 bytes) is used here. This produces a record containing 42 HEX characters (plus the colon). A record length of 18 HEX (24 bytes) will also fit on a 72-character teletype line, shortening the printed length of the program.

Two programming tricks are used in HEXMON. The subroutines

PHEX1 and HEX1 convert binary numbers to ASCII HEX using a DAA instruction twice. The error message routine near the end of the program uses the MITS DB trick to skip over an instruction. When entering from MERROR, the MVI A,"M" instruction is interpreted correctly. But when coming down from CHECK, the DB 1 makes the MVI instruction look like an LXI D. This saves two bytes, but more importantly, it avoids a JMP and makes for smoother top-down programming. □

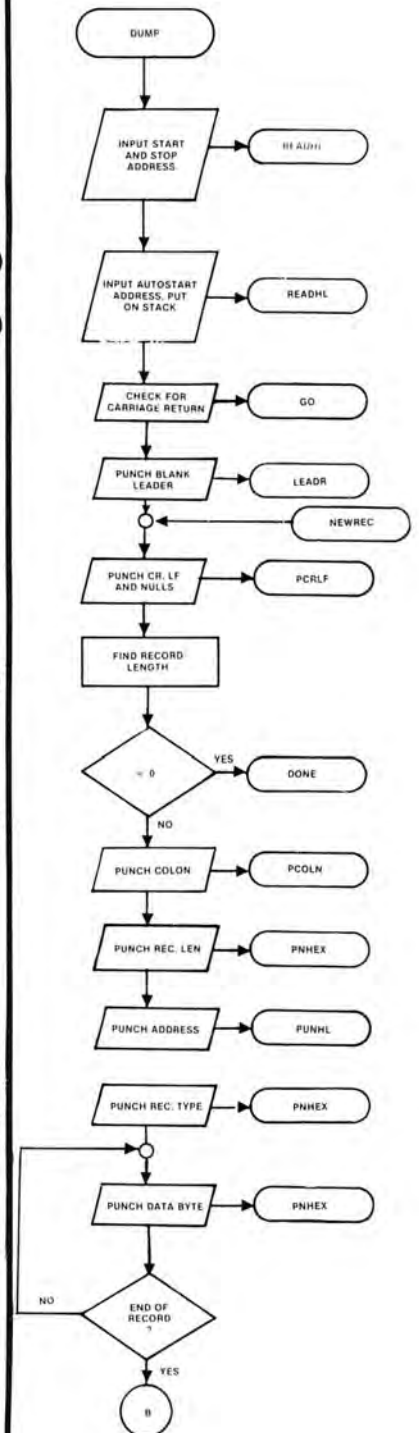
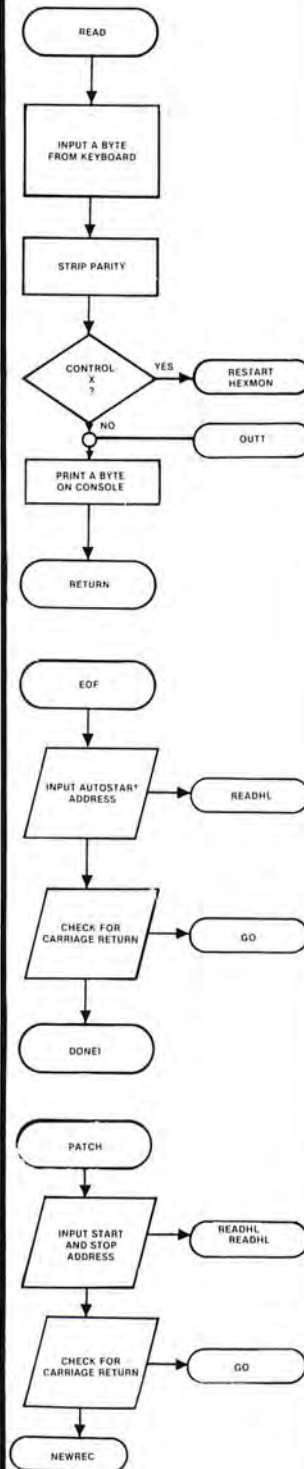
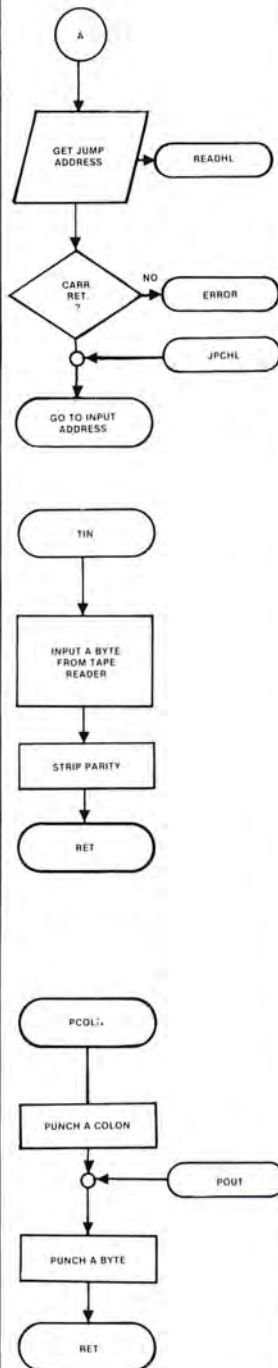
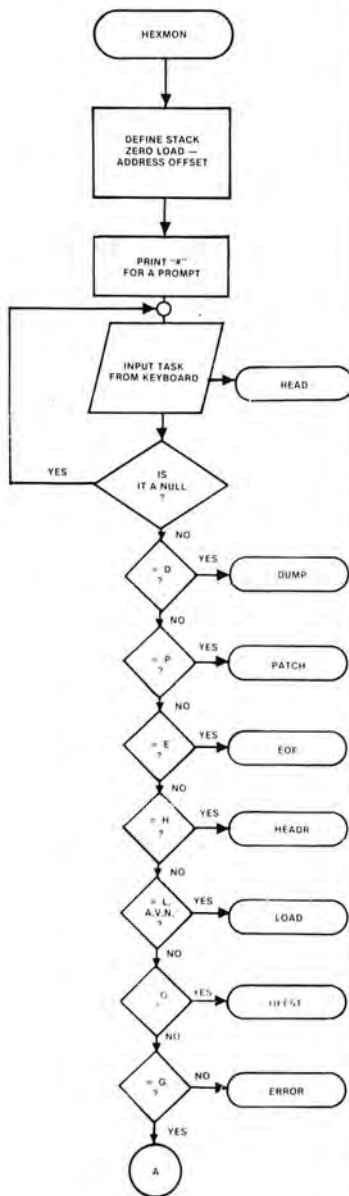
SOURCE PROGRAM VARIABLE	ADDRESS (HEX)	DATA (HEX)
Define stack	STACK 5C01	5E99
Record length	RLEN 5CC4	10
Console status addr	TYSTAT 5C6F, 5C80	10
Console data addr	TYDATA 5C76, 5C88	11
Input-ready mask	INMSK 5C71	1
Output-ready mask	OUTMSK 5C82	2
Jump zero	5C72, 5C83	CA
Tape status addr	TSTAT 5C55, 5C64	12
Tape data addr	TDATA 5C5C, 5C6C	13
Input-ready mask	TIM 5C67	1
Output-ready mask	TOM 5C66	2
Jump zero	5C58, 5C67	CA

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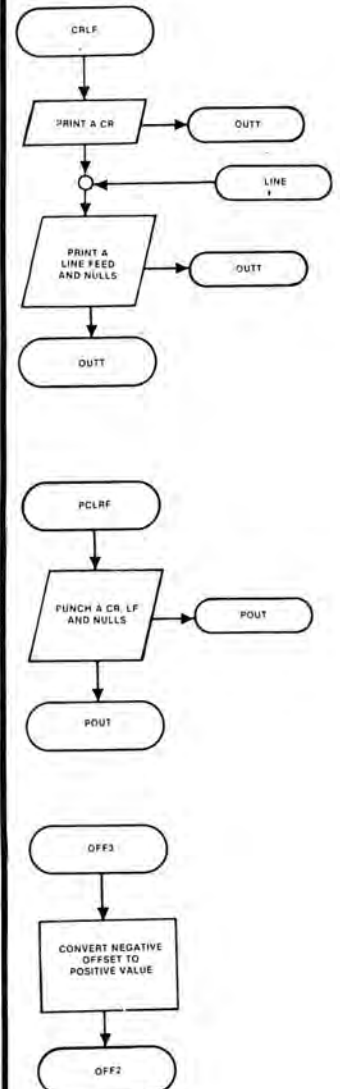
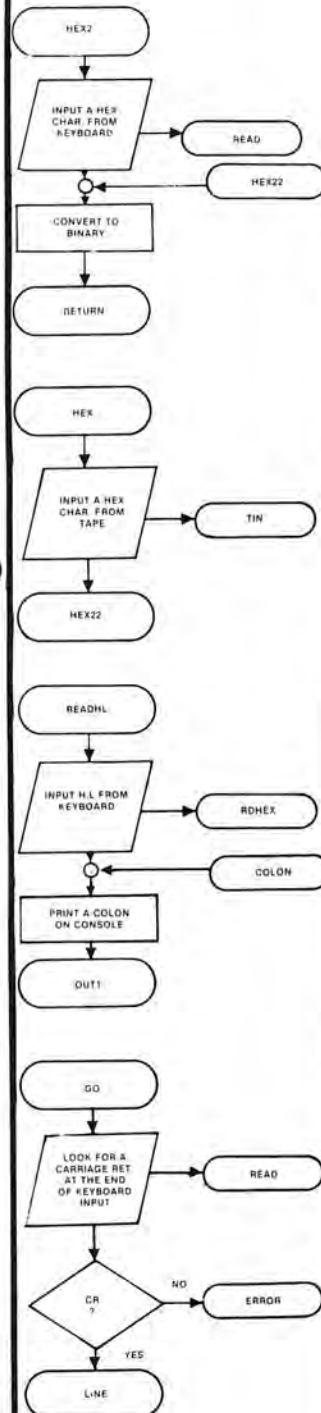
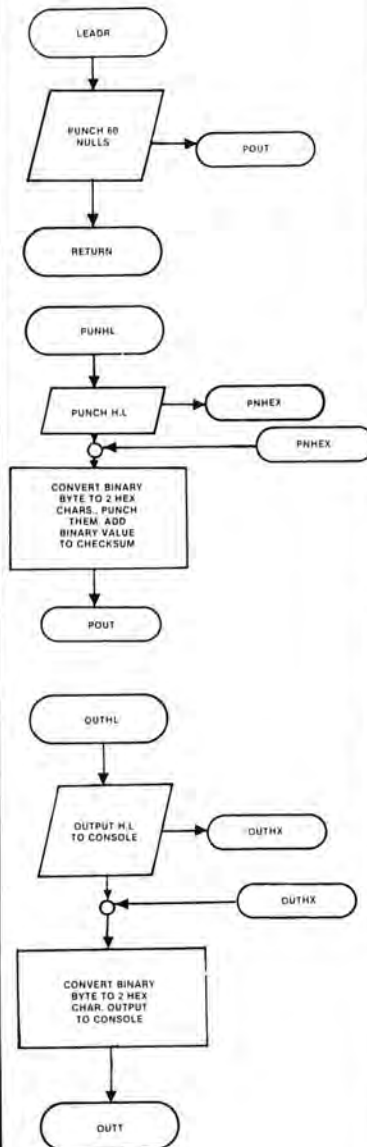
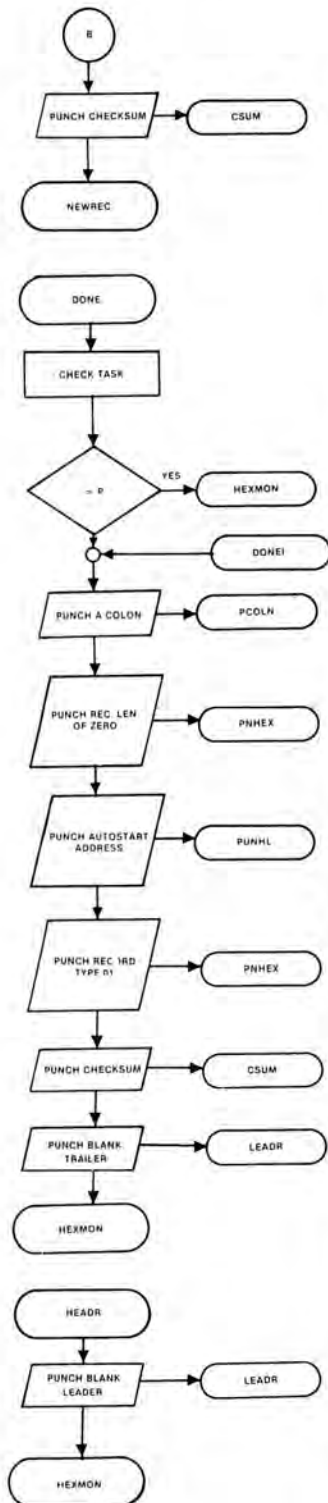
## INTEGRATED CIRCUITS

7400TTL	74LS00	45	1M0210	1.0	CMOS	CD4011	34	21078	4.00
7401	74LS01	25	1M0210	1.0	CMOS	CD4012	35	21111	7.00
7402	74LS02	25	1M0210	1.0	CMOS	CD4013	36	21112	7.00
7403	74LS03	25	1M0210	1.0	CMOS	CD4014	37	21113	7.00
7404	74LS04	25	1M0210	1.0	CMOS	CD4015	38	21114	7.00
7405	74LS05	25	1M0210	1.0	CMOS	CD4016	39	21115	7.00
7406	74LS06	25	1M0210	1.0	CMOS	CD4017	40	21116	7.00
7407	74LS07	25	1M0210	1.0	CMOS	CD4018	41	21117	7.00
7408	74LS08	25	1M0210	1.0	CMOS	CD4019	42	21118	7.00
7409	74LS09	25	1M0210	1.0	CMOS	CD4020	43	21119	7.00
7410	74LS10	25	1M0210	1.0	CMOS	CD4021	44	21120	7.00
7411	74LS11	25	1M0210	1.0	CMOS	CD4022	45	21121	7.00
7412	74LS12	25	1M0210	1.0	CMOS	CD4023	46	21122	7.00
7413	74LS13	25	1M0210	1.0	CMOS	CD4024	47	21123	7.00
7414	74LS14	25	1M0210	1.0	CMOS	CD4025	48	21124	7.00
7415	74LS15	25	1M0210	1.0	CMOS	CD4026	49	21125	7.00
7416	74LS16	25	1M0210	1.0	CMOS	CD4027	50	21126	7.00
7417	74LS17	25	1M0210	1.0	CMOS	CD4028	51	21127	7.00
7418	74LS18	25	1M0210	1.0	CMOS	CD4029	52	21128	7.00
7419	74LS19	25	1M0210	1.0	CMOS	CD4030	53	21129	7.00
7420	74LS20	25	1M0210	1.0	CMOS	CD4031	54	21130	7.00
7421	74LS21	25	1M0210	1.0	CMOS	CD4032	55	21131	7.00
7422	74LS22	25	1M0210	1.0	CMOS	CD4033	56	21132	7.00
7423	74LS23	25	1M0210	1.0	CMOS	CD4034	57	21133	7.00
7424	74LS24	25	1M0210	1.0	CMOS	CD4035	58	21134	7.00
7425	74LS25	25	1M0210	1.0	CMOS	CD4036	59	21135	7.00
7426	74LS26	25	1M0210	1.0	CMOS	CD4037	60	21136	7.00
7427	74LS27	25	1M0210	1.0	CMOS	CD4038	61	21137	7.00
7428	74LS28	25	1M0210	1.0	CMOS	CD4039	62	21138	7.00
7429	74LS29	25	1M0210	1.0	CMOS	CD4040	63	21139	7.00
7430	74LS30	25	1M0210	1.0	CMOS	CD4041	64	21140	7.00
7431	74LS31	25	1M0210	1.0	CMOS	CD4042	65	21141	7.00
7432	74LS32	25	1M0210	1.0	CMOS	CD4043	66	21142	7.00
7433	74LS33	25	1M0210	1.0	CMOS	CD4044	67	21143	7.00
7434	74LS34	25	1M0210	1.0	CMOS	CD4045	68	21144	7.00
7435	74LS35	25	1M0210	1.0	CMOS	CD4046	69	21145	7.00
7436	74LS36	25	1M0210	1.0	CMOS	CD4047	70	21146	7.00
7437	74LS37	25	1M0210	1.0	CMOS	CD4048	71	21147	7.00
7438	74LS38	25	1M0210	1.0	CMOS	CD4049	72	21148	7.00
7439	74LS39	25	1M0210	1.0	CMOS	CD4050	73	21149	7.00
7440	74LS40	25	1M0210	1.0	CMOS	CD4051	74	21150	7.00
7441	74LS41	25	1M0210	1.0	CMOS	CD4052	75	21151	7.00
7442	74LS42	25	1M0210	1.0	CMOS	CD4053	76	21152	7.00
7443	74LS43	25	1M0210	1.0	CMOS	CD4054	77	21153	7.00
7444	74LS44	25	1M0210	1.0	CMOS	CD4055	78	21154	7.00
7445	74LS45	25	1M0210	1.0	CMOS	CD4056	79	21155	7.00
7446	74LS46	25	1M0210	1.0	CMOS	CD4057	80	21156	7.00
7447	74LS47	25	1M0210	1.0	CMOS	CD4058	81	21157	7.00
7448	74LS48	25	1M0210	1.0	CMOS	CD4059	82	21158	7.00
7449	74LS49	25	1M0210	1.0	CMOS	CD4060	83	21159	7.00
7450	74LS50	25	1M0210	1.0	CMOS	CD4061	84	21160	7.00
7451	74LS51	25	1M0210	1.0	CMOS	CD4062	85	21161	7.00
7452	74LS52	25	1M0210	1.0	CMOS	CD4063	86	21162	7.00
7453	74LS53	25	1M0210	1.0	CMOS	CD4064	87	21163	7.00
7454	74LS54	25	1M0210	1.0	CMOS	CD4065	88	21164	7.00
7455	74LS55	25	1M0210	1.0	CMOS	CD4066	89	21165	7.00
7456	74LS56	25	1M0210	1.0	CMOS	CD4067	90	21166	7.00
7457	74LS57	25	1M0210	1.0	CMOS	CD4068	91	21167	7.00
7458	74LS58	25	1M0210	1.0	CMOS	CD4069	92	21168	7.00
7459	74LS59	25	1M0210	1.0	CMOS	CD4070	93	21169	7.00
7460	74LS60	25	1M0210	1.0	CMOS	CD4071	94	21170	7.00
7461	74LS61	25	1M0210	1.0	CMOS	CD4072	95	21171	7.00
7462	74LS62	25	1M0210	1.0	CMOS	CD4073	96	21172	7.00
7463	74LS63	25	1M0210	1.0	CMOS	CD4074	97	21173	7.00
7464	74LS64	25	1M0210	1.0	CMOS	CD4075	98	21174	7.00
7465	74LS65	25	1M0210	1.0	CMOS	CD4076	99	21175	7.00
7466	74LS66	25	1M0210	1.0	CMOS	CD4077	100	21176	7.00
7467	74LS67	25	1M0210	1.0	CMOS	CD4078	101	21177	7.00
7468	74LS68	25	1M0210	1.0	CMOS	CD4079	102	21178	7.00
7469	74LS69	25	1M0210	1.0	CMOS	CD4080	103	21179	7.00
7470	74LS70	25	1M0210	1.0	CMOS	CD4081	104	21180	7.00
7471	74LS71	25	1M0210	1.0	CMOS	CD4082	105	21181	7.00
7472	74LS72	25	1M0210	1.0	CMOS	CD4083	106	21182	7.00
7473	74LS73	25	1M0210	1.0	CMOS	CD4084	107	21183	7.00
7474	74LS74	25	1M0210	1.0	CMOS	CD4085	108	21184	7.00
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7479	74LS79	25	1M0210	1.0	CMOS	CD4090	113	21189	7.00
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7481	74LS81	25	1M0210	1.0	CMOS	CD4092	115	21191	7.00
7482	74LS82	25	1M0210	1.0	CMOS	CD4093	116	21192	7.00
7483	74LS83	25	1M0210	1.0	CMOS	CD4094	117	21193	7.00
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7487	74LS87	25	1M0210	1.0	CMOS	CD4098	121	21197	7.00
7488	74LS88	25	1M0210	1.0	CMOS	CD4099	122	21198	7.00
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7491	74LS91	25	1M0210	1.0	CMOS	CD4102	125	21201	7.00
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7493	74LS93	25	1M0210	1.0	CMOS	CD4104	127	21203	7.00
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7498	74LS98	25	1M0210	1.0	CMOS	CD4109	132	21208	7.00
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7500	74LS100	25	1M0210	1.0	CMOS	CD4111	134	21210	7.00
7501	74LS101	25	1M0210	1.0	CMOS	CD4112	135	21211	7.00
7502	74LS102	25	1M0210	1.0	CMOS	CD4113	136	21212	7.00
7503	74LS103	25	1M0210	1.0	CMOS	CD4114	137	21213	7.00
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7505	74LS105	25	1M0210	1.0	CMOS	CD4116	139	21215	7.00
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7528	74LS128	25	1M0210	1.0	CMOS	CD4139	162	21238	7.00
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7530	74LS130	25	1M0210	1.0	CMOS	CD4141	164	21240	7.00
7531	74LS131	25	1M0210	1.0	CMOS	CD4142	165	21241	7.00
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7533	74LS133	25	1M0210	1.					

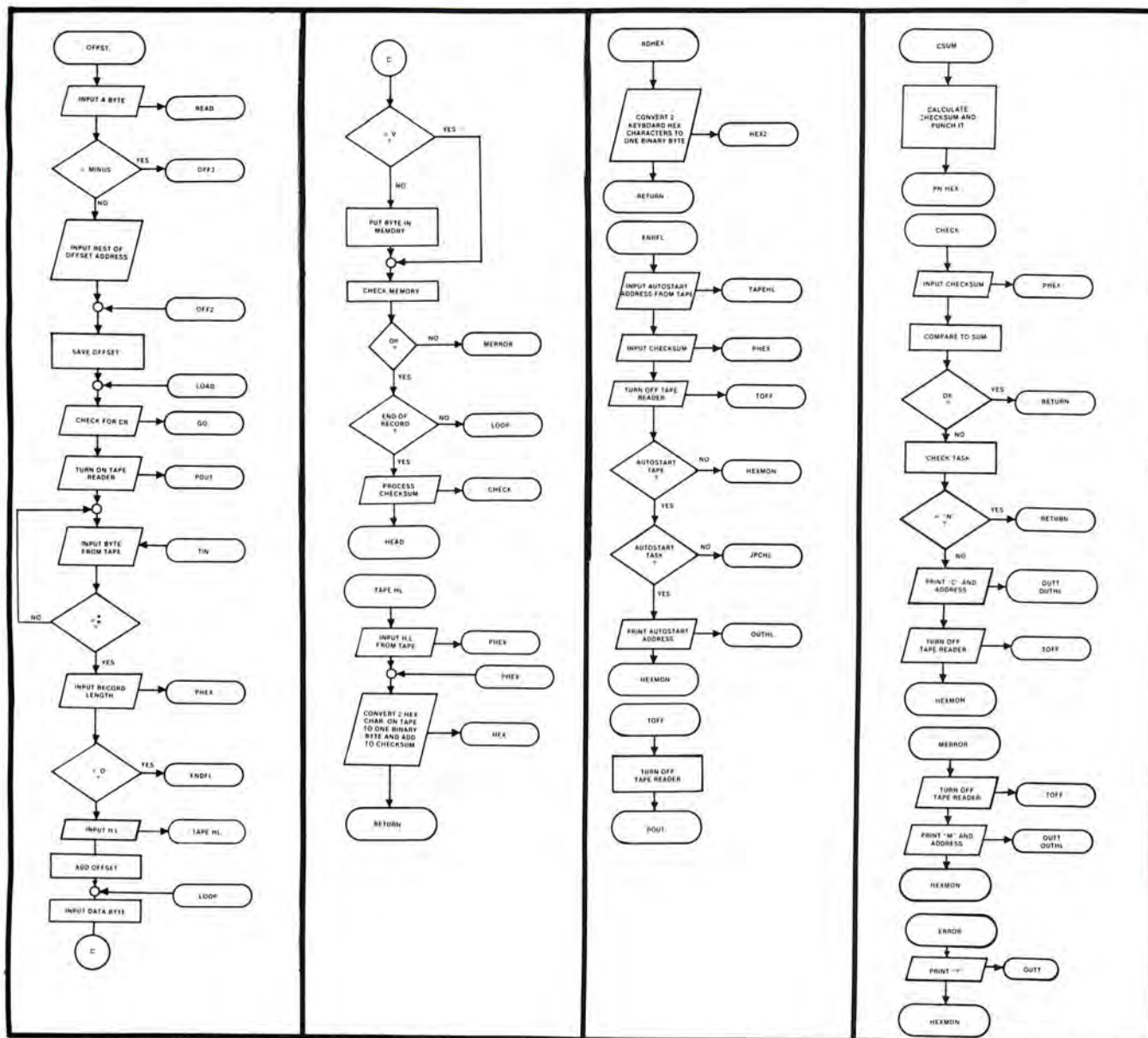












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;REXMON: A MONITOR TO DUMP, LOAD, AND VERIFY
; INTEL HEX CHECKSUM TAPES, WITH
; OPTIONAL AUTOSTART (LOAD AND GO).
;
;PROGRAMMED FOR AN 8080 MICROPROCESSOR
;BY ALAN R. MILLER
;NEW MEXICO TECH, SDCORR, NM 87801
; 505-835-5619 SEPTEMBER 16, 1977
;
;REQUIRES 664 BYTES OF MEMORY.
;KEYBOARD ADDRESS IS 10/11 HEX (20/21 OCTAL)
;TAPE ADDRESS IS 12/13 HEX (22/23 OCTAL)
;IF TAPE READER IS AUTOMATIC, THE PROGRAM
;WILL START AND STOP IT.
;
;WHEN STARTED AT "START", PROGRAM PRINTS
;A "X" AS A PROMPT.
;
;TO LOAD A TAPE, TYPE AN "L" FOLLOWED BY A CARRIAGE
;RETURN (CR).
;
;TO LOAD AND AUTOSTART A TAPE (PUNCHED WITH
;THAT FEATURE) TYPE AN "A" AND CR.
;
;TO VERIFY A TAPE AGAINST MEMORY TYPE A "V" AND A CR.
;
;TO LOAD A NON-CHECKSUMMED TAPE TYPE AN "N" AND A CR.
;
;TO LOAD A TAPE AT OTHER THAN ITS NORMAL ADDRESS, TYPE
;AN "Q", A TWO-BYTE (4-CHARACTER) OFFSET ADDRESS TO BE
;ADDED TO H.L. AND A CARRIAGE RETURN. AS THE TAPE
;LOADS AT THE NEW ADDRESS, THE CHECKSUM WILL BE
;PROPERLY CALCULATED. AN OFFSET OF 0400 WILL LOAD
;THE TAPE 1K HIGHER, AN OFFSET OF F000 OF -1000
;WILL LOAD THE TAPE 1K LOWER.
;
;TO DUMP A PORTION OF MEMORY TO TAPE ENTER A "D",
;THE START ADDRESS (MOST SIGNIFICANT BYTE
;FIRST), THE STOP ADDRESS, THE EXECUTE (AUTO-
;START) ADDRESS AND A CR. THE LAST RECORD
;WILL HAVE A ZERO RECORD LENGTH, THE AUTO-
  
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; START ADDRESS, AND A RECORD TYPE OF 1 TO
; INDICATE AUTOSTART.
;
;SEVERAL NON-CONTIGUOUS PATCHES CAN BE PUNCHED AS
;ONE TAPE. TYPE AN "H" TO PRODUCE A BLANK HEADER.
;THEN TYPE A "P", THE START AND STOP ADDRESS, AND
;A CARRIAGE RETURN FOR EACH PATCH REGION. FINALLY
;TYPE AN "E", AN AUTOSTART ADDRESS, AND A CR TO
;PUNCH THE END-OF-FILE RECORD AND A BLANK TRAILER.
;
;ENTER A "G", FOLLOWED BY AN ADDRESS AND CR TO GO
;SOMEWHERE ELSE, E.G. TO RETURN TO YOUR
;REGULAR MONITOR.
;CONTROL-X ON INPUT WILL RESTART THIS PROGRAM.
;
;WHEN A CHECKSUM ERROR OCCURS, A "C" AND THE
;ADDRESS WILL BE PRINTED.
;A MEMORY ERROR (LOADING INTO PROTECTED OR NON-
;EXISTENT MEMORY) WILL PRINT AN "M" AND THE
;ADDRESS. A "?" WILL BE PRINTED ON IMPROPER
;KEYBOARD INPUT, AND THE PROGRAM WILL BE
;RESTARTED.
;
;EQUATES
;
;RLEN EQU 16 ;RECORD LENGTH
;TYDATA EQU 11H ;KEYBOARD DATA ADDRESS
;TYSTAT EQU 10H ;KEYBOARD STATUS ADDRESS
;INMSK EQU 1 ;KEYBOARD INPUT-READY MASK
;OUTMSK EQU 2 ;KEYBOARD OUTPUT-READY MASK
;TDATA EQU 13H ;TAPE DATA ADDRESS
;TSTAT EQU 12H ;TAPE STATUS ADDRESS
;TIM EQU 1 ;TAPE INPUT-READY MASK
;TOM EQU 2 ;TAPE OUTPUT-READY MASK
;CR EQU 0DH ;CARRIAGE RETURN
;LF EQU 0AH ;LINE FEED
;
;SC00 31995E START: LXI SP,STACK ;STACK IS AT END
  
```



[illegible]



```

SUBROUTINE TO OUTPUT A HEX CHARACTER
FROM LOWER BITS
J
HEX1: ANI 0FH ;MASK UPPER 4 BITS
SD50 E60F
SD52 C690
SD54 27
SD55 C640
SD57 27
SD58 C37E5C
JMP 0UTT

SUBROUTINE TO INPUT A HEX CHARACTER FROM KEYBOARD
J
HEX2: CALL READ ;GET CHARACTER
HEX22: SUI "0" ;SUBTRACT ASCII BIAS
JC ERROR ;ERROR, < "0"
CPI 23
JNC ERROR ;ERROR, GREATER THAN "F"
CPI 10
JNC 0-9
SD5B C06E5C
SD5E D630
SD60 D0805E
SD63 FE17
SD65 D2805E
SD68 FE0A
SD6A D8
SD6B D607
SD6D FE0A
SD6F D0805E
SD72 C9
JC ERROR ;ERROR, BETWEEN "9"-"A"
;CHARACTER IS A-F
RET

SUBROUTINE TO INPUT A HEX CHARACTER FROM TAPE
J
HEX: CALL TIN ;INPUT A BYTE FROM TAPE
JMP HEX22

SUBROUTINE TO INPUT H/L FROM KEYBOARD
J
READHL: CALL RDHEX ;READ HIGH HALF
RHL2: MOV H,A ;STORE IN H
CALL RDHEX ;READ LOW HALF
MOV L,A ;STORE IN L
SD79 C02E5E
SD7C 67
SD7D C02E5E
SD80 6F
J
COLON: MVI A,":" ;OUTPUT A COLON
JMP 0UTT

SUBROUTINE TO LOOK FOR A CARRIAGE RETURN
AT THE END OF A KEYBOARD INPUT LINE
J
G0: CALL READ ;READ INPUT
CPI CR ;A CARRIAGE RETURN?
JNZ ERROR ;NO
JMP LINE

;CARRIAGE RETURN, LINE FEED AND NULLS
J
CRLF: MVI A,CR ;CARRIAGE RETURN
CALL 0UTT
LINE: MVI A,LF ;LINE FEED
CALL 0UTT
XRA A ;GET A ZERO
CALL 0UTT ;TWO NULLS
JMP 0UTT

SUBROUTINE TO PUNCH A CR, LF, NULLS
J
PCRLF: MVI A,CR ;CARRIAGE RETURN
CALL P0UT ;PUNCH IT
MVI A,LF ;A LINE FEED
CALL P0UT ;PUNCH IT
XRA A ;GET A ZERO
CALL P0UT ;PUNCH TWO NULLS
JMP P0UT

SD83 C0795D
SD86 AF
SD87 95
SD88 6F
SD89 3E00
SD8B 9C
SD8C 67
SD8D C3D25D
JFF3: CALL READHL ;INPUT NEGATIVE HEX OFFSET
XRA A ;GET A ZERO
SUB L ;INVERT L
MOV L,A ;SAVE IT
MVI A,0 ;ZERO WITHOUT RESETING CARRY
SBB H ;INVERT H
MOV H,A ;SAVE IT
JMP JFF2

;ENTRY FOR OFFSET LOADING
J
SDC0 4F
SDC1 C06E5C
SDC4 FE2D
SDC6 C0B35D
SDC9 C05E5D
SDCC C0315E
SDCF C07C5D
SDD2 22885E
SDD5 79
JFF2: SHLD JFSET ;SAVE OFFSET IN MEMORY
MOV A,C ;RETRIEVE TASK
JMP JFF2

;ENTRY FOR LOAD, AUTOSTART AND VERIFY
J
LOAD: CALL G3 ;LOOK FOR CR
MVI A,11H ;TURN ON TAPE READER
CALL P0UT

SUBROUTINE TO PROCESS THE RECORD HEADING ON INPUT
J
HEAD: CALL TIN ;INPUT A CHAR. FROM TAPE
CPI "1" ;IS IT A COLON?
JNZ HEAD ;NO, TRY AGAIN
CALL PHEX ;INPUT RECORD LENGTH
MOV B,E ;START CHECKSUM WITH IT
ORA A ;IS IT ZERO?
JZ ENDFL ;YES, DONE
MOV C,A ;NO, SAVE REC. LEN. IN C
CALL TAPEHL ;GET H/L
XCHG ;PUT ADDRESS IN D,E
LHLD JFSET ;FETCH OFFSET
DAD D ;ADD TO ADDRESS
LDA TASK ;FETCH TASK
MOV D,A ;SAVE IN D
JFFB: CALL PHEX ;INPUT DATA BYTE

SDFE 7A
S0FF FE56
S001 7B
S002 C0A05E
S005 77
S006 BE
S007 C0705E
S00A 23
S00B 0D
S00C C0F85D
S00F C0635E
S012 C0DE5D
MOV A,D ;LOOK AT TASK
CPI "V" ;SEE IF VERIFYING
MOV A,E ;MOVE DATA BACK TO A
JZ SKIP ;JUMP IF VERIFYING
MOV M,A ;STORE DATA IN MEMORY
CMP M ;CHECK MEMORY
JNZ ERROR ;BAD MEMORY
INX H ;INCREMENT MEMORY POINTER
DCR C ;DECREMENT RECORD LENGTH
JNZ L00P ;REC. LENGTH NOT YET 0
CALL CHECK ;PROCESS CHECKSUM
JMP HEAD ;START NEXT RECORD

SUBROUTINE TO INPUT H/L, RECORD TYPE FROM TAPE
J
TAPEHL: CALL PHEX ;READ H
MOV H,A
CALL PHEX ;READ L
MOV L,A
J
READ RECORD TYPE
J
;CONVERT 2 CHARACTERS FROM TAPE TO ONE BINARY
WORD, STORE IN A AND ADD TO CHECKSUM
J
PHEX: CALL HEX ;READ UPPER CHARACTER
RLC ;MOVE TO UPPER
RAL ;HALF
MOV E,A ;SAVE IT
CALL HEX ;INPUT LOWER CHARACTER
ADD E ;COMBINE BOTH
MOV E,A ;SAVE IT
ADD B ;ADD IT TO CHECKSUM
MOV B,A ;SAVE IT
MOV A,E ;RETRIEVE DATA BYTE
RET

SUBROUTINE TO CONVERT TWO KEYBOARD
HEX CHARACTERS TO ONE BINARY WORD
J
RDHEX: CALL HEX2 ;READ UPPER CHARACTER
RLC ;ROTATE TO
RAL ;UPPER HALF
MOV B,A ;SAVE IT
CALL HEX2 ;READ LOWER CHARACTER
ADD B ;COMBINE BOTH
MOV B,A ;SAVE IT IN B
RET

SUBROUTINE TO CHECK FOR AUTOSTART
J
ENDFL: CALL TAPEHL ;GET AUTOSTART ADDRESS
AND RECORD TYPE
PUSH PSW ;SAVE RECORD TYPE
CALL PHEX ;INPUT CHECKSUM
CALL T0FF ;TURN OFF TAPE READER
POP PSW ;RETRIEVE RECORD TYPE
CPI 1 ;TYPE 1 (AUTOSTART)?
JNZ START ;NOT AN AUTOSTART TAPE
MOV A,D ;CHECK TASK
CPI "A" ;AUTOSTART?
JZ JPHCL ;YES, JUMP TO ADDRESS
CALL 0UTHL ;NO, PRINT HL
JMP START ;NEXT TASK

SUBROUTINE TO TURN OFF TAPE READER
J
T0FF: MVI A,13H
JMP P0UT

SUBROUTINE TO CALCULATE AND PUNCH THE CHECKSUM
J
CSUM: MOV A,B ;MOVE CHECKSUM TO A
CMA ;COMPLEMENT IT
ADD 1 ;ADD 1
JMP PHEX ;PUNCH CHECKSUM

SUBROUTINE TO SEE IF CHECKSUM IS CORRECT (ZERO)
J
CHECK: CALL PHEX ;INPUT CHECKSUM
XRA A ;GET A ZERO
ADD B ;IS CHECKSUM ZERO?
RZ ;YES, RETURN
MOV A,D ;CHECK COMMAND
CPI "N" ;IS TAPE CHECKSUMMED?
RZ ;NO, RETURN

;ERROR MESSAGES
J
MVI A,"C" ;C FOR CHECKSUM ERROR
DB 1 ;BITS DB TRICK TO SKIP
MERRR: MVI A,"M" ;PRINT M FOR BAD
PUSH PSW ;PRINT M FOR BAD
CALL T0FF ;TURN OFF TAPE READER
POP PSW
CALL 0UTT ;PRINT ERROR TYPE
CALL 0UTHL ;PRINT H/L
JMP START

ERROR: MVI A,"?" ;PRINT "?" FOR IMPROPER
CALL 0UTT ;KEYBOARD INPUT
JMP START

JFFSET: DW 0 ;OFFSET-LOAD VECTOR
TASK: DS 1 ;CURRENT TASK
DS 14 ;STACK SPACE
STACK: DS 1 ;TOP OF STACK

```



# A Relative Jump Ruler

## Speeds Machine Language Programming

By John S. MacDougall

Machine language programming of a microprocessor like the F8, 6800, 6502 or Z-80 requires tedious hex arithmetic or counting of lines to determine the second byte of a relative jump instruction. For the novice, this is a confusing task; for the expert it becomes a tiresome chore. The confusion and tedium of relative jump calculations can be reduced with the simple and easy-to-make relative jump ruler shown in the illustration.

The figure illustrates a relative jump ruler (designed for the F8) in use on a coding sheet. Notice that the ruler has two columns of figures to allow both forward and backward jumps. This covers about 80% of the actual cases. For the remaining 20%, hex arithmetic must be used or additional columns added to the ruler. These are used by dropping backward (or forward) three hexades, for example, and then using the extra columns to calculate the jump.

The coding sheet illustrated contains an actual program (the jump to location 16D is 05). Naturally, the coding sheet and the ruler must have the same line spacing. The back side of the ruler can be used for important, but easily forgotten, pieces of information relating to I/O ports and sense digits. □

Ruler In Position For A Relative Jump To Location 16D<sub>H</sub>. The Second Byte Would Thus Be "05"

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	74242	1.89	7415304	1.26	U7357M	1.20
	74243	1.89	7415305	1.26	U7357M	1.20
	74244	1.89	7415306	1.26	U7357M	1.20
	74245	1.89	7415307	1.26	U7357M	1.20
	74246	1.89	7415308	1.26	U7357M	1.20
	74247	1.89	7415309	1.26	U7357M	1.20
	74248	1.89	7415310	1.26	U7357M	1.20
	74249	1.89	7415311	1.26	U7357M	1.20
	74250	1.89	7415312	1.26	U7357M	1.20
	74251	1.89	7415313	1.26	U7357M	1.20
	74252	1.89	7415314	1.26	U7357M	1.20
	74253	1.89	7415315	1.26	U7357M	1.20
	74254	1.89	7415316	1.26	U7357M	1.20
	74255	1.89	7415317	1.26	U7357M	1.20
	74256	1.89	7415318	1.26	U7357M	1.20
	74257	1.89	7415319	1.26	U7357M	1.20
	74258	1.89	7415320	1.26	U7357M	1.20
	74259	1.89	7415321	1.26	U7357M	1.20
	74260	1.89	7415322	1.26	U7357M	1.20
	74261	1.89	7415323	1.26	U7357M	1.20
	74262	1.89	7415324	1.26	U7357M	1.20
	74263	1.89	7415325	1.26	U7357M	1.20
	74264	1.89	7415326	1.26	U7357M	1.20
	74265	1.89	7415327	1.26	U7357M	1.20
	74266	1.89	7415328	1.26	U7357M	1.20
	74267	1.89	7415329	1.26	U7357M	1.20
	74268	1.89	7415330	1.26	U7357M	1.20
	74269	1.89	7415331	1.26	U7357M	1.20
	74270	1.89	7415332	1.26	U7357M	1.20
	74271	1.89	7415333	1.26	U7357M	1.20
	74272	1.89	7415334	1.26	U7357M	1.20
	74273	1.89	7415335	1.26	U7357M	1.20
	74274	1.89	7415336	1.26	U7357M	1.20
	74275	1.89	7415337	1.26	U7357M	1.20
	74276	1.89	7415338	1.26	U7357M	1.20
	74277	1.89	7415339	1.26	U7357M	1.20
	74278	1.89	7415340	1.26	U7357M	1.20
	74279	1.89	7415341	1.26	U7357M	1.20
	74280	1.89	7415342	1.26	U7357M	1.20
	74281	1.89	7415343	1.26	U7357M	1.20
	74282	1.89	7415344	1.26	U7357M	1.20
	74283	1.89	7415345	1.26	U7357M	1.20
	74284	1.89	7415346	1.26	U7357M	1.20
	74285	1.89	7415347	1.26	U7357M	1.20
	74286	1.89	7415348	1.26	U7357M	1.20
	74287	1.89	7415349	1.26	U7357M	1.20
	74288	1.89	7415350	1.26	U7357M	1.20
	74289	1.89	7415351	1.26	U7357M	1.20
	74290	1.89	7415352	1.26	U7357M	1.20
	74291	1.89	7415353	1.26	U7357M	1.20
	74292	1.89	7415354	1.26	U7357M	1.20
	74293	1.89	7415355	1.26	U7357M	1.20
	74294	1.89	7415356	1.26	U7357M	1.20
	74295	1.89	7415357	1.26	U7357M	1.20
	74296	1.89	7415358	1.26	U7357M	1.20
	74297	1.89	7415359	1.26	U7357M	1.20
	74298	1.89	7415360	1.26	U7357M	1.20
	74299	1.89	7415361	1.26	U7357M	1.20
	74300	1.89	7415362	1.26	U7357M	1.20
	74301	1.89	7415363	1.26	U7357M	1.20
	74302	1.89	7415364	1.26	U7357M	1.20
	74303	1.89	7415365	1.26	U7357M	1.20
	74304	1.89	7415366	1.26	U7357M	1.20
	74305	1.89	7415367	1.26	U7357M	1.20
	74306	1.89	7415368	1.26	U7357M	1.20
	74307	1.89	7415369	1.26	U7357M	1.20
	74308	1.89	7415370	1.26	U7357M	1.20
	74309	1.89	7415371	1.26	U7357M	1.20
	74310	1.89	7415372	1.26	U7357M	1.20
	74311	1.89	7415373	1.26	U7357M	1.20
	74312	1.89	7415374	1.26	U7357M	1.20
	74313	1.89	7415375	1.26	U7357M	1.20
	74314	1.89	7415376	1.26	U7357M	1.20
	74315	1.89	7415377	1.26	U7357M	1.20
	74316	1.89	7415378	1.26	U7357M	1.20
	74317	1.89	7415379	1.26	U7357M	1.20
	74318	1.89	7415380	1.26	U7357M	1.20
	74319	1.89	7415381	1.26	U7357M	1.20
	74320	1.89	7415382	1.26	U7357M	1.20
	74321	1.89	7415383	1.26	U7357M	1.20
	74322	1.89	7415384	1.26	U7357M	1.20
	74323	1.89	7415385	1.26	U7357M	1.20
	74324	1.89	7415386	1.26	U7357M	1.20
	74325	1.89	7415387	1.26	U7357M	1.20
	74326	1.89	7415388	1.26	U7357M	1.20
	74327	1.89	7415389	1.26	U7357M	1.20
	74328	1.89	7415390	1.26	U7357M	1.20
	74329	1.89	7415391	1.26	U7357M	1.20
	74330	1.89	7415392	1.26	U7357M	1.20
	74331	1.89	7415393	1.26	U7357M	1.20
	74332	1.89	7415394	1.26	U7357M	1.20
	74333	1.89	7415395	1.26	U7357M	1.20
	74334	1.89	7415396	1.26	U7357M	1.20
	74335	1.89	7415397	1.26	U7357M	1.20
	74336	1.89	7415398	1.26	U7357M	1.20
	74337	1.89	7415399	1.26	U7357M	1.20
	74338	1.89	7415400	1.26	U7357M	1.20
	74339	1.89	7415401	1.26	U7357M	1.20
	74340	1.89	7415402	1.26	U7357M	1.20
	74341	1.89	7415403	1.26	U7357M	1.20
	74342	1.89	7415404	1.26	U7357M	1.20
	74343	1.89	7415405	1.26	U7357M	1.20
	74344	1.89	7415406	1.26	U7357M	1.20
	74345	1.89	7415407	1.26	U7357M	1.20
	74346	1.89	7415408	1.26	U7357M	1.20
	74347	1.89	7415409	1.26	U7357M	1.20
	74348	1.89	7415410	1.26	U7357M	1.20
	74349	1.89	7415411	1.26	U7357M	1.20
	74350	1.89	7415412	1.26	U7357M	1.20
	74351	1.89	7415413	1.26	U7357M	1.20
	74352	1.89	7415414	1.26	U7357M	1.20
	74353	1.89	7415415	1.26	U7357M	1.20
	74354	1.89	7415416	1.26	U7357M	1.20
	74355	1.89	7415417	1.26	U7357M	1.20
	74356	1.89	7415418	1.26	U7357M	1.20
	74357	1.89	7415419	1.26	U7357M	1.20
	74358	1.89	7415420	1.26	U7357M	1.20
	74359	1.89	7415421	1.26	U7357M	1.20
	74360	1.89	7415422	1.26	U7357M	1.20
	74361	1.89	7415423	1.26	U7357M	1.20
	74362	1.89	7415424	1.26	U7357M	1.20
	74363	1.89	7415425	1.26	U7357M	1.20
	74364	1.89	7415426	1.26	U7357M	1.20
	74365	1.89	7415427	1.26	U7357M	1.20
	74366	1.89	7415428	1.26	U7357M	1.20
	74367	1.89	7415429	1.26	U7357M	1.20
	74368	1.89	7415430	1.26	U7357M	1.20
	74369	1.89	7415431	1.26	U7357M	1.20
	74370	1.89	7415432	1.26	U7357M	1.20
	74371	1.89	7415433	1.26	U7357M	1.20
	74372	1.89	7415434	1.26	U7357M	1.20
	74373	1.89	7415435	1.26	U7357M	1.20
	74374	1.89	7415436	1.26	U7357M	1.20
	74375	1.89	7415437	1.26	U7357M	1.20
	74376	1.89	7415438	1.26	U7357M	1.20
	74377	1.89	7415439	1.26	U7357M	1.20
	74378	1.89	7415440	1.26	U7357M	1.20
	74379	1.89	7415441	1.26	U7357M	1.20
	74380	1.89	7415442	1.26	U7357M	1.20



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\$100 BUS COMPATIBLE

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breaks input power 10 mA

0.1 and 10 min. x 4.5

where to be mA

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1.5 volts

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• SPECIAL

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• MAXIMUM FORWARD

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CURRENT — 25 mA

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CURRENT — 25 mA

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7400	18	7441	75	7496	80	74160	130
7401	20	7442	50	7497	400	74161	130
7402	20	7443	120	74100	125	74162	130
7403	20	7444	105	74107	40	74163	140
7404	20	7445	105	74108	150	74164	150
7405	25	7447	85	74110	80	74165	140
7406	35	7448	95	74116	200	74166	150
7407	35	7450	30	74121	125	74167	300
7408	25	7451	20	74121	55	74170	200
7409	25	7453	20	74122	45	74172	90
7410	20	7454	20	74123	95	74173	150
7411	25	7460	20	74125	55	74174	110
7412	40	7470	40	74126	60	74175	120
7413	75	7472	75	74128	65	74176	150
7416	35	7473	40	74132	150	74177	90
7417	40	7474	40	74136	180	74178	100
7420	20	7475	70	74141	115	74181	200
7422	75	7476	40	74142	400	74182	90
7425	35	7479	200	74144	400	74184	200
7426	30	7480	60	74145	110	74185	200
7427	35	7482	150	74147	250	74186	1200
7428	40	7483	85	74148	175	74190	140
7429	40	7485	110	74150	100	74191	125
7430	25	7486	40	74151	110	74192	110
7432	30	7487	40	74153	20	74193	110
7433	40	7490	55	74154	110	74194	120
7437	30	7491	110	74155	110	74195	100
7438	35	7492	10	74156	110	74196	100
7439	36	7493	60	74157	120	74197	130
7440	20	7494	85	74158	175	74198	150
		7495	90	74159	360	74199	175

74LS00	29	74LS192	225
74LS01	29	74LS193	225
74LS02	29	74LS194	187
74LS03	29	74LS195	187
74LS04	29	74LS196	187
74LS05	35	74LS221	200
74LS06	35	74LS222	200
74LS10	29	74LS241	200
74LS11	29	74LS242	200
74LS12	50	74LS243	200
74LS13	60	74LS244	200
74LS14	170	74LS245	200
74LS15	40	74LS246	200
74LS16	40	74LS247	200
74LS17	40	74LS248	200
74LS18	40	74LS249	200
74LS19	40	74LS250	200
74LS20	40	74LS251	200
74LS21	40	74LS252	200
74LS22	40	74LS253	200
74LS23	40	74LS254	200
74LS24	40	74LS255	200
74LS25	40	74LS256	200
74LS26	40	74LS257	200
74LS27	40	74LS258	200
74LS28	40	74LS259	200
74LS29	40	74LS260	200
74LS30	40	74LS261	200
74LS31	40	74LS262	200
74LS32	40	74LS263	200
74LS33	40	74LS264	200
74LS34	40	74LS265	200
74LS35	40	74LS266	200
74LS36	40	74LS267	200
74LS37	40	74LS268	200
74LS38	40	74LS269	200
74LS39	40	74LS270	200
74LS40	40	74LS271	200
74LS41	40	74LS272	200
74LS42	40	74LS273	200
74LS43	40	74LS274	200
74LS44	40	74LS275	200
74LS45	40	74LS276	200
74LS46	40	74LS277	200
74LS47	40	74LS278	200
74LS48	40	74LS279	200
74LS49	40	74LS280	200
74LS50	40	74LS281	200
74LS51	40	74LS282	200
74LS52	40	74LS283	200
74LS53	40	74LS284	200
74LS54	40	74LS285	200
74LS55	40	74LS286	200

### 74LS00

## CMOS

34001	40	4050	61	4517	850
4000	25	4051	110	4518	165
4001	25	4052	110	4519	90
4002	25	4053	110	4520	165
4003	25	4054	110	4521	325
4004	350	4060	325	4522	175
4006	140	4061	700	4523	300
4007	25	4062	250	4524	300
4008	125	4066	85	4528	175
4009	48	4067	600	4583	145
4010	48	4068	35	4584	75
4011	25	4069	35		
4012	25	4070	85		
4013	60	4071	35		
4014	60	4072	35		
4015	125	4073	35		
4016	50	4074	35		
4017	125	4075	185		
4018	125	4077	42		
4019	70	4078	35		
4020	125	4081	35		
4021	125	4082	35		
4022	125	4083	145		
4023	125	4084	145		
4024	100	4089	300		
4025	35	4098	250		
4026	25	4099	250		
4027	60	4160	175		
4028	125	4162	175		
4029	150	4163	175		
4030	60	4174	175		
4032	160	4175	160		
4033	200	4194	180		
4034	350	4501	38		
4035	160	4502	175		
4036	160	4503	115		
4040	150	4506	70		
4041	145	4507	70		
4042	125	4508	400		
4043	120	4510	175		
4044	125	4511	175		
4045	250	4512	150		
4046	195	4514	475		
4047	250	4515	475		
4048	100	4516	175		
4049	61	4517	175		

### LINEAR

LM300H	170	LM211N	135
LM301AH	35	LM2900N	90
LM301AN	35	LM2901N	90
LM302H	75	LM2902N	90
LM304H	250	LM2903N	160
LM307H	50	LM2904N	160
LM307H	50	LM2905N	160
LM308AH	325	LM2906N	160
LM308AN	300	LM2907N	160
LM308H	100	LM2908N	160
LM308H	100	LM2909N	160
LM309H	100	LM2910N	160
LM310H	15	LM2911N	200
LM311H	200	LM2912N	200
LM311H	90	LM2913N	200
LM311H	80	LM2914N	200
LM311H	80	LM2915N	200
LM311H	80	LM2916N	200
LM311H	80	LM2917N	200
LM311H	80	LM2918N	200
LM311H	80	LM2919N	200
LM311H	80	LM2920N	200
LM311H	80	LM2921N	200
LM311H	80	LM2922N	200
LM311H	80	LM2923N	200
LM311H	80	LM2924N	200
LM311H	80	LM2925N	200
LM311H	80	LM2926N	200
LM311H	80	LM2927N	200
LM311H	80	LM2928N	200
LM311H	80	LM2929N	200
LM311H	80	LM2930N	200
LM311H	80	LM2931N	200
LM311H	80	LM2932N	200
LM311H	80	LM2933N	200
LM311H	80	LM2934N	200
LM311H	80	LM2935N	200
LM311H	80	LM2936N	200
LM311H	80	LM2937N	20



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MICROPROCESSOR'S	8080A SUPPORT DEVICES	CHARACTER GENERATORS	PROM'S	MISC. OTHER COMPONENTS
F-8 19.95 Z-80 25.00 Z-80A 35.00 CDP1802CD 24.95 AM2901 22.95 6502 12.95 6800 19.95 8008-1 8.75 8080A 15.95 TMS-9900TL 89.95	8212 3.95 8214 9.95 8216 4.50 8274 4.95 8278 8.75 8238 8.00 8251 12.00 8253 28.00 8255 12.00 8257 25.00 8259 25.00	2513 UP 6.75 2513 DOWN 6.75 2513 UP (5v) 9.95 2513 DOWN (5v) 10.95 MCM6571 10.80 MCM6571A 10.80 MCM6572 10.80 MCM6574 14.75 MCM6575 14.75	1702A 5.00 2704 15.00 2708 13.00 2716 38.00 3601 4.50 5203AQ 4.00 5204AQ 6.00 6834 16.95 6834-1 14.95 82523B 4.00 8223B 2.70	NH0025CN 1.70 NH0026CN 2.50 N8T20 3.50 N8T26 2.45 74367 90 DM8098 90 1488 1.95 D-3207A 2.00 C-3404 3.95 P-3408A 5.00 P-4201 4.95 MM-5320 7.50 MM-5369 1.90 DM-8130 2.90 DM8131 2.75 DM-8831 2.50 DM-8833 2.50 DM-8835 2.50 SN74LS367 90 SN74LS368 90
<b>6800 SUPPORT</b> 6810P 4.95 6820P 8.00 6828P 11.25 6834P 16.95 6850P 9.95 6852P 11.95 6860P 14.95 6862P 17.95 6880P 2.70	<b>STATIC RAMS</b> 21L02 (450) 1.50 21L02 (250) 1.95 21L11 4.75 1101A 1.49 2101 2.95 2102 1.25 2102 1 1.50 2111 4.00 2112 3.00 2114 17.95 4200A 12.95 5101C-E 11.95	<b>KEYBOARD CHIPS</b> 8038 4.00 MC4024 2.50 566 1.75	<b>DYNAMIC RAMS</b> 1103 1.50 2104 4.50 2107A 3.75 2107B 4.50 2107B-4 4.00 TMS4050 4.50 TMS4060 4.50 4096 4.50 4116 42.00 MM5270 5.00 MM5280 6.00 MCM6605 6.00	<b>KIM</b> KIM-1 245.00 6502 12.95 6520 9.00 6522 9.25 6530-002 15.95 6530-003 15.95 6530-004 15.95 6530-005 15.95
<b>Z80 SUPPORT DEVICES</b> 3881 12.95 3882 12.95	<b>WAVEFORM GENERATOR</b> 8038 4.00 MC4024 2.50 566 1.75		<b>UART'S</b> AY5-1013A 5.50 AY5-1014A 8.95 TR-1602A 5.50 TMS 6011 6.95 IM-6402 10.80 IM-6403 10.80	<b>USRT</b> S 2350 10.95
<b>LATE ADDITIONS</b> TMS 4044 \$14.00 TMS 5501 \$24.95		<b>FLOPPY DISC CONTROLLER</b> 1771B 55.95 1771B-01 59.95		

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32 or 64 Characters per line  
16 lines  
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5204-6834

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- \* Includes Main Module Board and External EPROM Socket Unit
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- \* Programming is accomplished by the Computer
- \* Just Read in the Program to be Written on the EPROM into your Processor and let the Computer do the rest
- \* Use Socket Unit to Read EPROM's Contents into your Computer
- \* Software included
- \* No External Power Supplies. Your Computer does it all
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A CAPABLE LOW COST. APPROACH TO REMOTE VIDEO DISPLAY TERMINALS.

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# CAREER OPPORTUNITIES

Dear Reader:

INTERFACE AGE Magazine, in its attempt to provide you with functional information on a monthly basis, has added this new department to its publication. The purpose of CAREER OPPORTUNITIES is to keep you in touch with those companies that are rapidly expanding and in need of qualified and dependable personnel. It is our goal to assist in advancing the state of the art through communications. Thus, you can look forward to these pages monthly to bring you current career opportunities which are available.

**WANTED:** We are expanding and need technicians for microcomputer systems repair, programming, installations, field representation for systems analysis. If you want the opportunity to grow with this technology, then send us your resume and salary history today. BYTE SHOP of Pasadena, 496 S. Lake Avenue, Pasadena, CA 91101, (213) 684-3311.

**SOFTWARE ENGINEERS:** TSC has challenging openings, for all levels of experience, that will allow you to push the state-of-the-art in Software Engineering. If you are interested in the hardware/software interface, mini- and micro-based systems, real-time software, parallel and associative processing, interactive graphics software, FORTRAN and assembly-level scientific software, contact us for more information, or send your resume to: Data Sciences Division, Technology Service Corporation, 2811 Wilshire Boulevard, Santa Monica, CA 90403, Attention: Ms. P. Mickelsen.

## Microcomputer Research & Development

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Our NYSE Corporation with over 20 years of successful growth serving the small business market offers excellent salary, full company paid benefits and modern facilities in a convenient suburban mid-eastern state location.

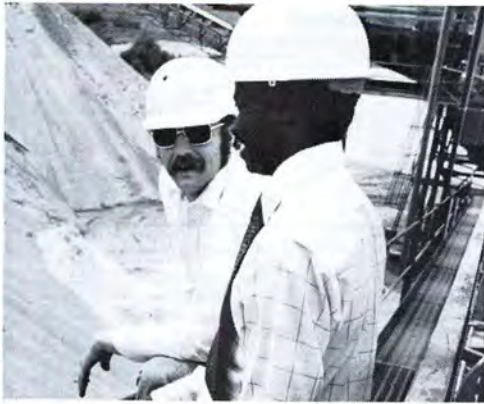
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CIRCLE INQUIRY NO. 40



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We're looking for Field Engineers/Technicians with experience in one or more of these areas:

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- Core and semiconductor memory
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# Software Specialists



We're looking for Software Specialists with experience in one or more of these areas:

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# **FIFO FLEA MARKET**

**FOR SALE:** Terminal. Texas Instruments 725, 30 char/sec hard copy, built in modem/coupler, rugged, portable case. Very quiet. \$775 plus shipping. Solid State Music 8K static, 500 nsec (no waits), assembled, works, \$150. Wright, Box 7576, Menlo Park, CA 94025, (415) 854-5678.

**FOR SALE:** Solid State Music MB3 4K EPROM board with 4K of 1702As, \$110. Assembled, tested and guaranteed. D. Wong, 11266 Monterey Ct., Cupertino, CA 95014, (408) 253-3240 evenings.

**TRS-80 OWNERS:** I have fully tested inexpensive software packages on cassettes. All run under Level I BASIC with 4K RAM. Level II available later this year. I also custom build programs to your specs, reasonably priced. Send S.A.S.E. to Jerry Hicks, 1910 Grant St., Malvern, ARK 72104, (501) 337-1443, after 6 p.m.

**FOR SALE:** MMD-1 by E&L Instruments, \$250, Bug Book V, (6 units) and operational manual included. Contact (805) 522-5276 after 6 p.m.

**FOR SALE:** Digital Group System with 8080 CPU, 6502 CPU, 26K RAM, EPROM card, 64/32 character displays, 2 Phidecks, and interface, keyboard, TV monitor, audio cassette, 25A power supply, CPU cabinet, software, BASIC assembler, editor, and games. All for \$1500. Bill Seiler, #202, 1717 Woodland Ave., Palo Alto, CA 94303, (415) 323-2083.

**FOR SALE:** PerSci 1070 intelligent floppy disk controller with high-level filing language in on-board 5K 8080 system, both parallel and RS232 interfaces and 4K EPROM, can run disk with only a terminal. \$200. S-100 bus adapter for above with additional 3K EPROM, 1K RAM and TDL Zapple monitor interfaced to disk, \$100. EPROMs burned to your order. G. Lyons, 280 Henderson, Jersey City, NJ 07302, (201) 451-2905.

**FOR SALE:** North Star BASIC programs: Correspondence Editor: \$5.00. Stock Market analysis package: \$5.00. Mailing list-random access package: \$3.00. Spacewar game package: \$3.00. Plus stock market data on 30 heavily traded companies on North Star disc. Includes: P/E, Price, Volume, and % yield - weekly averages for 1977: \$25.00 for all 30. Send blank disc or include \$5.25 for disc. Write for complete list. Herbert Schildt, 1007 N. Division, Urbana, IL 61801.

**FOR SALE:** Altair 680b with all documentation. Very little left to do, to have up and running. For \$200, I pay shipping, its yours. W.J. Spencer, V-2 Div., U.S.S. America CV66, FPO NY, NY 09501.

**NCR high speed paper tape punches,** 110V/60Hz, used but overhauled; about

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**FOR SALE:** Custom KIM-1 in Viatron mainframe and cabinet with keyboard, 2 digital cassette decks, 5K RAM, 5 S-100 sockets, D-A converter, ps, Tiny BASIC, chess, mini disassembler, much more software. \$545 or best offer. Paul Peckins, 52 Monument Ave., Charlestown, MA 02129, (617) 241-7629 after 6 p.m.

**FOR SALE OR TRADE:** Computer game programs and other BASIC software. All program inquiries should be accompanied with a reasonable offer. All acceptable offers will receive a prompt reply. A list of all available programs is currently unavailable, sorry. John Klein, 60 Glann Rd., Apalachin, NY 13732.

**FOR SALE:** KIM-1, CT-1024 CRT controller, keyboard, cursor controller, serial interface, memory, power supply, 9" CRT, shielded cable and connectors. All ICs socketed, \$425. COSMAC Elf \$60. Bob Ellison, 784 Carol Ave., Elgin, IL 60120, (312) 695-8297.

**SOL-20 user seeks others to exchange ideas, solutions, software and whatever.** Willing to edit a newsletter if enough interest is shown. Send SASE for reply when heads are counted. F. Roberts, Box 608, Dana Point, CA 92629.

**FOR SALE:** OAE-OP-80A paper tape reader, \$60.00, 2KRO PROM board \$60.00, works great. Call or write J. Washburn, 23822 Via Astorga, Mission Viejo, CA 92675, (714) 830-7130.

**FOR SALE:** 3 Processor Technology 16KRA, 16K memory boards. Rev. E. Factory assembled, like new. \$250 each. Write Sam Fromm, 1959 Napa St., Berkeley, CA 94707.

**FOR SALE:** Southwest Technical Products 6800 Computer System. KBD-3, TVT-II with modulator, AC-30, 8K interface cards, two recorders, software. Beautiful custom cases. Packaged for portability, \$650.00. Anderson-Jacobsen 841 Selectronic Terminal. Correspondence code, RS-232 interface, modem and coupler. Attractive case, \$725.00. Daniel L. Wright, 280 Perrymont Ave., San Jose, CA 95125. (408) 925-3367 days.

**FOR SALE:** Teletype Model 15 Receive-Only model. Was recently in service with UPI. Will sell for \$180.00 or best offer. Functions perfectly. Computer terminal,

made by Riker-Maxon, was used in TELEMAX Hotel Reservation System. Uses Baudot keyboard, with ASCII logic, if desired. Can use either teletypewriter or video display. Neither included, but easy to obtain. Terminal includes 28 special purpose keys, with which you can tailor the system to your requirements. ASCII PC board and components, boxer fan and full manuals included. \$200.00 or offer. Steven M. Garber, 3030 Polk St., San Francisco, CA 94109.

**MICRODATA 1600 CPU (REALITY) WANTED** for above: mag tape controller and disc controller. Jack Hardman, 140 Forest Ave., Glen Ridge, NJ 07028, (201) 429-8880.

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**RADIO SHACK TRS-80:** Anyone know of a users' group? Also interested in interfacing experience of other TRS-80 users, as well as a software exchange. Leo Waltz, 3808 Laura Leigh, Friendswood, TX 77546.

**WANTED:** Programs on 8" iCOM 3700 Disk Subsystem. I use iCOM -58, DEBBI/IMSAI and FDOS 111. I also use the Cromemco Dazzler and the Cybernetic speech synthesizer. Please send me a copy of your disk and I will pay you for it. Dr. John M. Larimer, 55 La Gorce Cir., Miami Beach, FL 33131.

**FOR SALE:** AUGAT wire wrap boards with built in sockets. Will hold 24 7400 series ICs or any combination of larger and smaller ICs. \$8.00 ea. ppd. of \$10.00 with 72 pin wire wrap edge connector. Model 33 Teletype R.O. ASCII 100 wpm table top model w/manual and copy holder, \$400.00 ppd. in U.S. Robert Savilonis, 334 Columbia St., Cambridge, MA 02141, (617) 492-2095.

**PET-2001 and Radio Shack TRS-80 arrived on campus.** I am surveying users and will report result to any interested hobbyists. Write: Prof. Bill Parks, Walters State Community College, Morristown, TN 37814.

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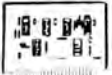
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